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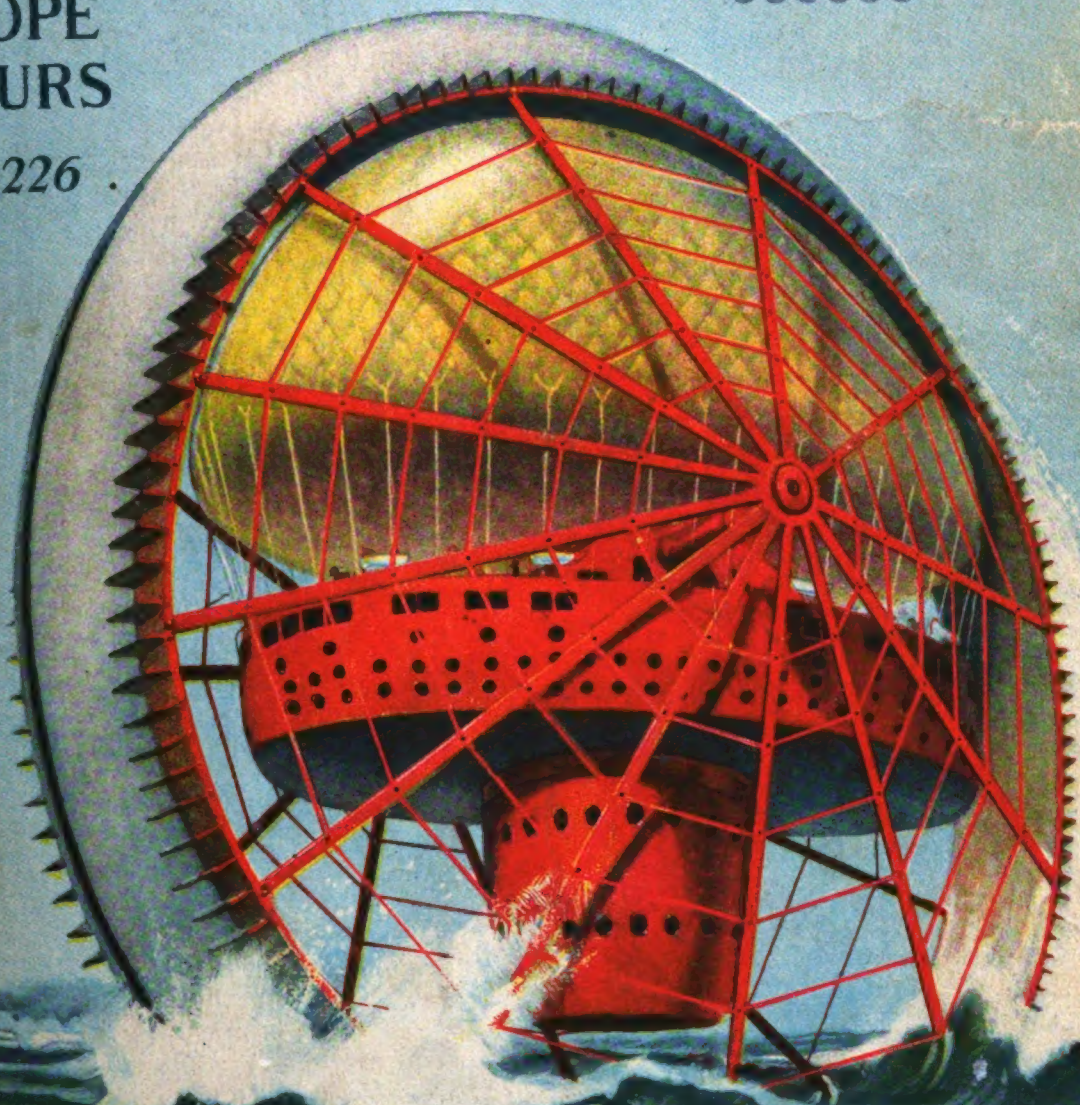
See Page 226 .



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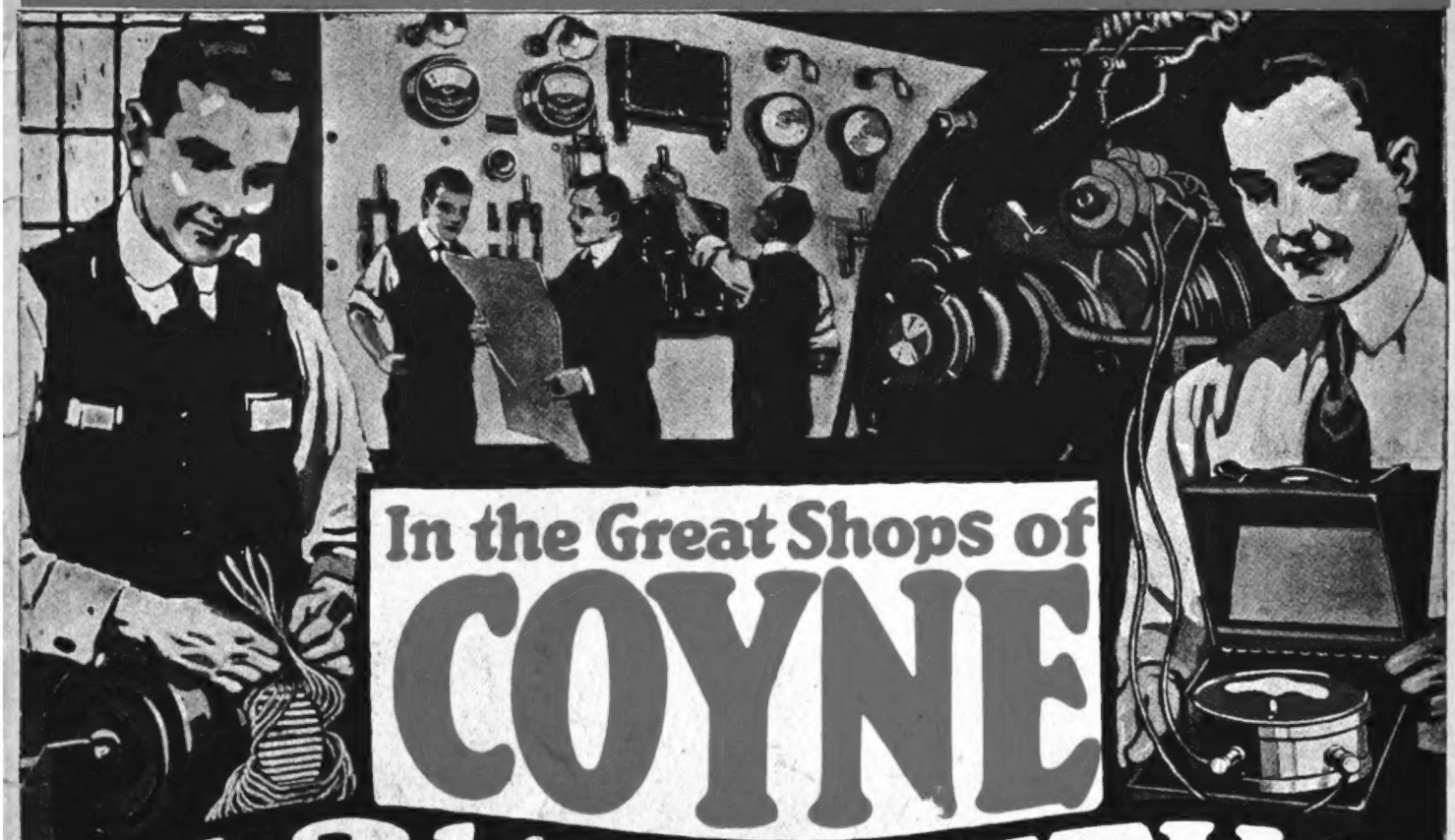

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Vol. IX
Whole No. 99

Science and Invention

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233 FULTON STREET-NEW YORK

July, 1921
No. 3

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The Deadly Habit

THE one element that holds back all human progress, all development, all expansion, all invention and discovery, can be exprest in a single word: Habit. Nothing is more deadly, nothing holds you back, more than your habits. A habit steals upon you unawares, ensnares you in its meshes, and before you realize it, it has become a part of you. Most of our habits thus stay with us till death puts a stop to them. All of this is trite and commonplace enough, and has been commented upon by philosophers of all ages.

Suppose you were to sit down for an hour, and suppose you were to give that time making an *analytical* catalog of your daily habits, analysing each one carefully. Write down the most trifling routine—which is but a habit—of *everything* you do from the time you rise, till you fall asleep. You will find that it is an undertaking of a vast magnitude, because each one of us has several thousand habits, nine hundred of which we are absolutely unconscious of.

Now after you have analyzed each and every small habit, apply a little common sense to them, one by one, and ask yourself if you cannot improve upon each particular habit. You may have to ponder for weeks at a time over a very simple one, but if you pursue this new sport to its logical conclusion, you will be rich and independent in a few years.

Examples? Millions of them. To mention but a few. Since the days of the old Egyptians, human beings were in the habit of using needles with the eye at one end, the point at the other. A young American, Howe by name, after thinking hard and earnestly upon that simple, innocent old habit, decided to improve upon it. He placed the eye right over the needle's point. Result: the sewing machine, made possible by killing an old habit.

For centuries people were in the habit of dipping goose-quills and, later, pens into inkstands. A young Englishman, about 1830, thought the habit a bad one. So he put the inkstand right *into* the pen itself—result, the fountain pen. (P. S. Won't some chap now *please* put a blotter on or into our fountain pens, to cure us of that other deadly habit: the blotting paper!)

Then there was the habit of putting tips on shoelaces that were made to pull off, instead of staying on. So a young fellow, whose temper was aroused by trying to thread a tipless shoe-lace into the eyelet of his shoe, sat down on his bed and cussed lustily. Then he went downtown, and made a model of the now famous Beaded Tip. Doesn't cost any more than the ones that pulled off—but this one is on the job long after the lace wears out. Oh yes, that young fellow, who slayed the antique habit, is quite rich now.

For centuries women were in the habit of wearing hairpins, the kind that, for just as many centuries, kept on falling out, as quickly as milady stuck them in. Another young American, who noticed that the dance floor was strewn thick with hairpins, picked up one and thought awhile. Next day he invented a hairpin with wavy prongs, instead of the old straight ones. The habit of falling pins was cured, and incidentally the young man left millions when he died.

Then we have the lazy young clerk, who was peeved because he had to copy the customer's name from the letter and write it out on the envelop. Humanity had the habit of doing this ever since Pharaoh's days. But this young fellow thought that writing a man's name *once* was sufficient—without copying it on an envelop. So he invented the "open face" or "window envelop." The massacre of that ancient habit made him so rich, that he has to travel abroad, to escape being snowed under with dollars.

Now suppose you get busy and kill a few habits.

H. GERNSBACK.

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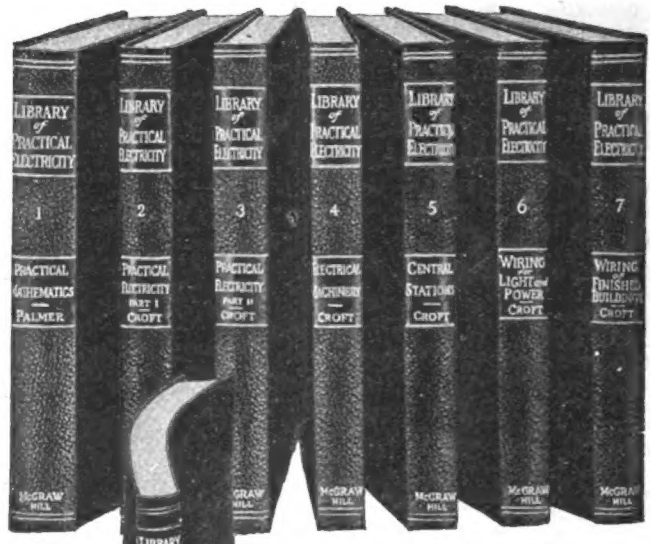

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Volume IX
Whole No. 99

Science and Invention

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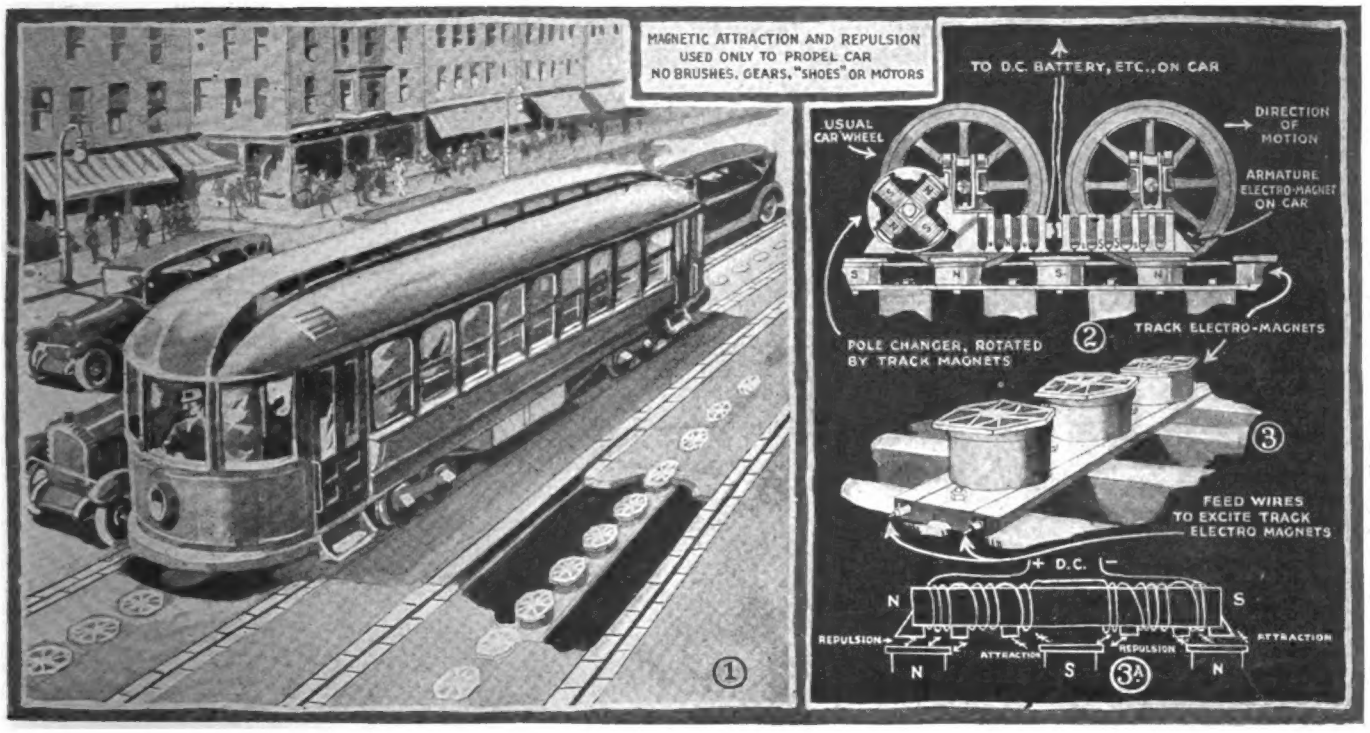
JULY
1921
No. 3

A New Magnetic Motorless Railway



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One of the Latest Designs for Electro-Magnetic Railways is Illustrated in Detail Above. No Motors or Gearing are Employed in This System of Propelling Cars by Means of Electro-Magnets, Placed Between the Tracks in the Manner Indicated. Only the Group of Track Magnets Directly Under the Car at Any Moment Are Magnetized. The Repulsion and Attraction Forces Existing at a Given Moment, Between the Track Magnets and the Powerful Electro-Magnet or Magnets Carried Underneath the Car, May be Readily Understood by Studying the Diagrams at the Right of the Illustration, Remembering the Basic Law of Magnetism That—Like Poles Repel, While Unlike Poles Attract.

THE magnetic railway shown in the accompanying illustration, represents one of the latest ideas in transportation. It is based on the principle that action or movement can be and is produced between an electro-magnet and an iron mass or between two electro-magnets, in contra-distinction to the usual electrical railway with which we are all familiar, in which one or more high speed electric motors are used to drive the car wheels thru a system of gears. The present magnetic railway is known as the "Leffler System."

As in every magnetic railway system, the individual magnets in the street, which are placed several feet apart, are only magnetized in short sections as the car passes along. The idea will be evident to anyone who is familiar with the laws of magnetism. Referring for a moment to Fig 2 as well as Fig 3A, it will be seen how successive attraction and repulsion forces are set up between the electro-magnets in the track and the electro-magnet mounted under the car or engine. The moving electro-magnet on the car may be excited by direct current supplied by a battery on the car.

Just how the car is propelled will be understood from the following, referring to Fig. 3A. The first law of magnetism states that like poles repel and unlike poles attract each other; the arrows in the figure show, by the direction in which they point, how these forces operate. Starting at the left hand side, we see that two north poles are opposite each other at the moment selected for our cut, and that they tend to repel each other, while somewhat to the right a north pole is in juxtaposition with a south pole, causing attraction. A little further to the right we see that the south pole above is also in proximity to the central pole, which is south also, causing repulsion (like poles); at the extreme right we have attraction between the unlike poles once more, S above and N below.

As the electric current is past thru the windings of the armature, the downward projecting poles on the armature become polarized in groups, of three to four to a group, as indicated by letters N and S; the center of the groups being the most highly magnetized. These groups of polarity appear alternately every two and a half feet, or half way between the magnets in the track, which in turn also become magnetized, as indicated by the letters N, S, on the track magnets. Opposite poles are attracted, while like poles are repelled, both forces acting to move the armature and thus the car, in the direction indicated by the arrow. By reversing the current in the armature, a quick but easy stop can be

(*Continued on Page 271*)

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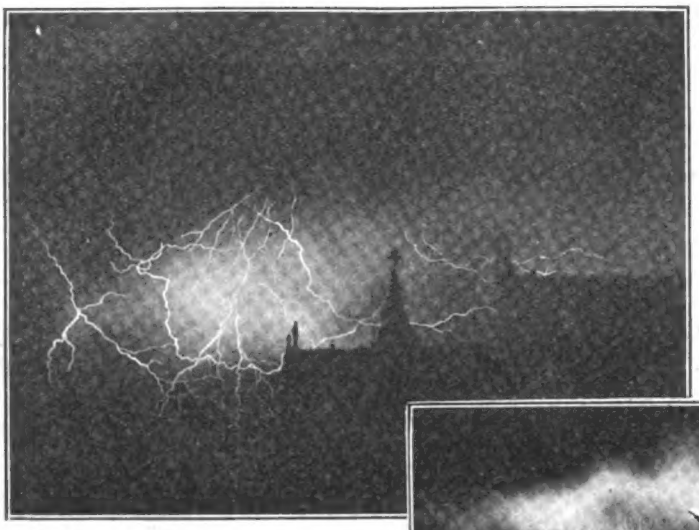
The Power of Lightning

By A. H. SCOTT

IT is not difficult to picture the terror of prehistoric man in the presence of the unleashed forces of nature and the awe in which he held thunder and lightning. His primitive fears were handed down through the ages to take shape in Thor, the Norsemen's God of Thunder, who, even in this enlightened age is reverenced unknowingly by those who draw the shades and seek the protection of a feather bed during a thunder storm. This fear of the unknown is as inherent in human beings as in the lower animals, and is not without a certain amount of justification, as for many centuries the philosophers have been quite unable to more than guess at the cause and identity of this most vivid evidence of nature's power.



This Photograph Was Taken by Allowing the Camera Plate to Be Exposed for Several Minutes During the Height of a Violent Thunder Storm, the Display Being Actually Several Miles Distant from the Church Which Appears to be in the Midst of It. The Voltage of Any One of These Flashes Is Approximately 50,000,000 Volts

Center View: Multiple Lightning Flash Taken Over a Body of Water

Photos Courtesy General Electric Co.

It was not until that great and many sided American, Benjamin Franklin, flew his silken kite in a thunder storm and drew an electric spark from the clouds, that man was able definitely to say that electricity and lightning were the same. Except for the questionable value of the use of lightning rods, this discovery led to little of practical value, and it is only within the past decade, which has witnessed the great extension of our net work of high voltage transmission lines, that our studies have yielded data which are even approximately correct.

It is not the purpose of this article to more than touch upon the causes of lightning but rather to give some idea of the power which produces the flash, by comparing it and the damage it causes, with certain known values of electrical effects.

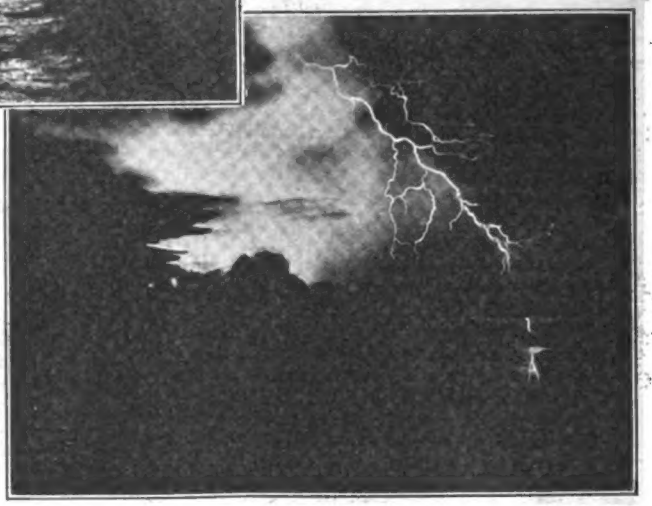
If we consider lightning as a purely disruptive discharge and as forcing its way thu the air due to its high potential value, and as following the laws which have been discovered in relation to the distance in air a certain known voltage will jump, we arrive at a figure beyond all reason when computing the potential of a flash several miles long. Flashes of this length are not uncommon during the course of an electrical storm as all will agree who have considered the matter at all. Considering for instance a flash of from two to three miles in length, it would require approximately one thousand million volts to leap this space or enough voltage to kill two million human beings, allowing five hundred volts as sufficient to cause death, if all were to stand in a continuous line with hands joined. If only a small amount of current flowed at this enormous voltage for only one one-hundred-thousandth part of a second, the destructive force would equal that caused if a fourteen hundred ton ship could be dropped from the cloud from which the flash came.

A still more vivid idea of the force, which would be liberated if the first supposition were true, may be gained, if we imagine two one thousand-ton trains rushing toward each other at a speed of fifty miles per hour and meeting in head-on collision. The destruction caused would be seventy-two times as great as that which would result from such a collision.

It is therefore apparent that the lightning flash is not caused by a potential of anywhere near a thousand million volts or the power which would necessarily be present if such were the case.

The theory has lately been advanced that lightning is the result of some internal rearrangement of static stresses in the atmosphere and that the great length of flash which attends this rearrangement is due to a local rupture of the air which becomes progressive in the direction of the earth or between two or more clouds, as in the case of forked lightning. Just what is meant by this rearrangement and the destruction which attends it, is best illustrated by dropping a small piece of carborundum into a bottle which will cause it to break into many pieces. The bottle, during the course of manufacture has been slowly cooled from a high temperature to make it tough, so that it will not break during the course of ordinary handling, and may even be dropped on the floor without being broken. The glass, due to this annealing process is left full of stresses, which are held in restraint by the hard, smooth outer surface of the bottle. When the small piece of carborundum, which is much harder than the glass, strikes the bottom of the bottle, a slight scratch is made which causes an equalization of the internal stresses so suddenly that

(*Continued on page 257*)



Photograph Showing the Progressive Nature of a Lightning Flash from Cloud to Cloud, Finally Reaching the Earth Through the Path of Least Resistance, Which Is the Moist Atmosphere Composing the Clouds. If Such a Flash Obeyed the Known Laws of Electricity It Would Indicate the Presence of Sufficient Voltage to Kill Approximately Two Million Human Beings

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WHAT A LIGHTNING FLASH COULD DO
TO PRODUCE A FLASH AND MAINTAIN IT FOR A FEW SECONDS WOULD REQUIRE 100,000 TONS OF COAL
A LIGHTNING FLASH OF FINITE DURATION COULD LIFT A BATTLESHIP
THE ENERGY IN A SINGLE FLASH COULD LIGHT A HOUSE FOR MANY NIGHTS
IN A MINUTE IT WOULD MELT 15,000 TONS OF COPPER
15,000 TONS
UNDER SIMILAR CONDITIONS IT COULD OPERATE A SOLENOID HAMMER OF ENORMOUS SIZE
IT WOULD EVAPORATE ABOUT 3,000 TONS OF WATER IF OF 1 MINUTE DURATION
IT WOULD PURIFY THE DRINKING WATER OF THE UNITED STATES IN SHORT ORDER BY GENERATING OZONE

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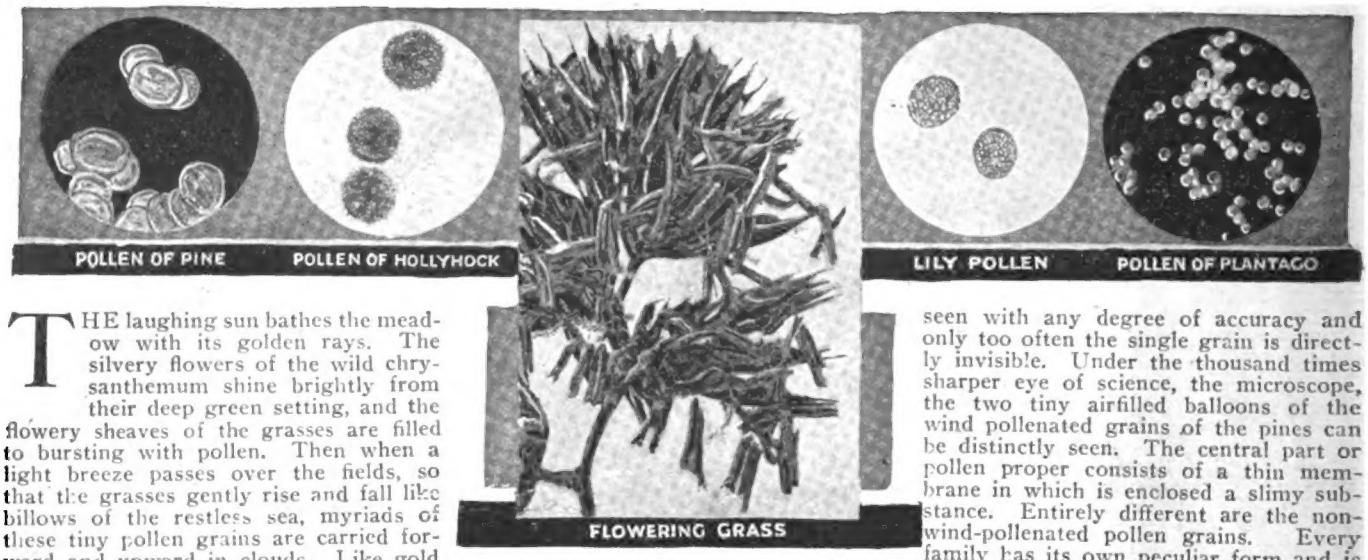
Hay Fever—Its Cause and Cure

By Dr. ERNEST BADE



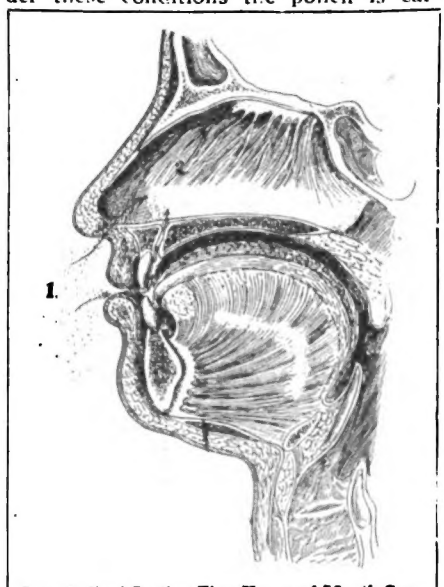
As the Summer Months Come Around Many People are Wondering Whether They Will be Troubled with that Great American Nuisance—"Hay Fever." Many Persons are Susceptible to the Protein Content of the Wind-Blown Pollen from Certain Flowers and Grasses. Several of These Pollen are Shown, Greatly Magnified, in the Above Illustrations Made by the Author in His Investigation of the Cause and Alleviation of "Hay Fever."

THE laughing sun bathes the meadow with its golden rays. The silvery flowers of the wild chrysanthemum shine brightly from their deep green setting, and the flowery sheaves of the grasses are filled to bursting with pollen. Then when a light breeze passes over the fields, so that the grasses gently rise and fall like billows of the restless sea, myriads of these tiny pollen grains are carried forward and upward in clouds. Like gold shimmering clouds they float onward, carried high into the infinite by the rising sun as if to show them the beauty of the fair earth from above. A glistening powder in the imperceptible breath of the air, these billions and billions of pollen grains float about. They are tiny Montgolfiers, and especially those of the pines which have two such balloons in which the air is heated to a higher temperature than that of the surrounding atmosphere by the sun. This lifts the pollen high into the air but at dusk it sinks back to the earth. The cooling of the atmosphere at night forces it down, and when the first dew drops appear like diamonds upon the grasses, it has completed the journey and has arrived at its destination. How far it has been carried in the sunny ether, bathed in light and heat, who can say? Many of the sartillas become lost in the dizzy heights, come down upon the far stretching mirror of the sea, or a summer thunderstorm overtakes them in their daring flight, only to hurl them down with torrents of rain. This imparts a yellowish color to the draining waters.

That dust, coming from the flower, is the pollen, which, after fertilizing the flower, allows the pistil to produce seeds. In the flowering grasses the anthers are held suspended by long filaments which, by the slightest breath, are set in pendulous motion. Then the anthers discharge their pollen into the air. In other plants the pollen, as soon as it is discharged, collects in some moist free spot of the flower, to await more favorable conditions for dispersal and when the conditions are right, the wind lifts the dust-like particles from their temporary resting places, and carries them high and far upon their long journey.

The purpose of this airy trip of the pollen is cross pollenation and it consists in the seeking of the stygma of the same kind of a flower in order to fertilize it. Many contingencies must be considered in these so called wind pollenators. For the pollen to fulfill its purpose it must find the same kind of a flower from which the pollen originated, and the flower must be ready to be fertilized. And this as a rule, is more or less an accident, and to make this probability more of a possibility, all wind pollenators expend most of their energy in producing enormous quantity of pollen.

The pollen of the varieties carried by the wind, is always dry and very tiny, but other plants produce other kinds of pollen. Here it appears as a gelatinous sticky mass, clubshaped or crumbly particles. Those plants which produce their pollen in the last mentioned class belong to the largest of all plant families. Under these conditions the pollen is carried by insects, but all these plants do not produce anywhere near as much pollen as the wind pollenators. The latter only comprise about one-tenth of the other plants.



Longitudinal Section Thru Nose and Mouth Cavities. 1—The Pollen Enters with the Breath, and Passes Into the Olfactory Cavity, as Indicated by the Arrows. 2—The Olfactory Cavity with the Olfactory Nerves. 3—Canal Leading from the Mouth to the Olfactory Cavity.

Observed with the naked eye, one of these pollen grains is too small to be seen with any degree of accuracy and only too often the single grain is directly invisible. Under the thousand times sharper eye of science, the microscope, the two tiny airfilled balloons of the wind pollenated grains of the pines can be distinctly seen. The central part or pollen proper consists of a thin membrane in which is enclosed a slimy substance. Entirely different are the non-wind-pollenated pollen grains. Every family has its own peculiar form and is provided with various individual designs. They are often globular, while the membrane is covered with spikes, balls, and other ornaments composing an artistic network; regular geometric figures, warts, knobs and other delicately sculptured designs are also often found on the membrane. These serve the purpose of attaching themselves to the hairs of insects that happen to visit the flower and are deposited by them, the unconsciously, on the stygma of other flowers of the same species. When the pollen has reached its destination, it opens its membrane on one particular spot and the contents of the pollen grain comes forth as a rapid growing thread penetrating the stygma, style, and ovary until the ovule or egg of the flower is reached. This it penetrates and the nucleus of the pollen fuses with the nucleus of the ovule, the flower is fertilized, and it begins to develop into the seed.

At present but few pollen grains have been chemically analyzed. In the dry state they contain insect food and it consists of 16 to 30 per cent proteins, 1 to 7 per cent starch, 0 to 15 per cent sugar, 3 to 10 per cent fat; the ash content is very low (3 to 9 per cent); it is rich in phosforic acid, potassium, and magnesium but poor in lime-content.

Many persons are susceptible to the protein content of the pollen, and especially of those pollens produced by the grasses. When such a person comes in contact with such pollen hay-fever sets in. The active proteins have been isolated and so were able to be studied. One drop of this substance in an exceedingly dilute solution when placed in the eye or upon the sensitive membrane of the nose, produces swellings in these organs, they become red and cause an itching as well as all of the characteristic symptoms of hay-fever. The tiny and minute floating pollen grains of the air produce the same symptoms, and 40 to 50 are sufficient to produce this sickness in an average individual, while 2 to 4 are sufficient for a sensitive person.

Those who have been [illegible] this sickness will surely fail [illegible] when nature has put on her festive costume, when everything has become

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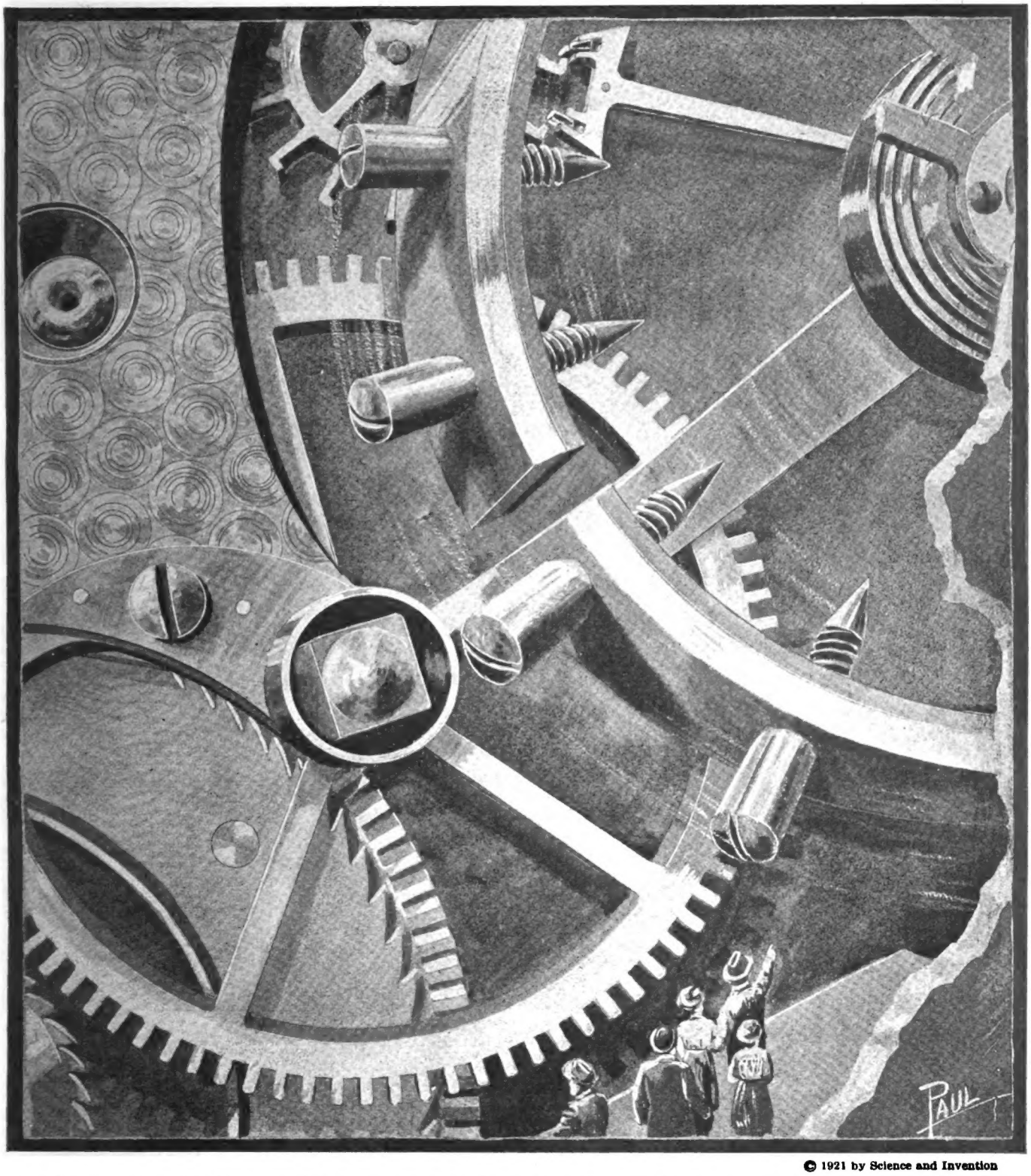

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Did You Ever Stop to Think What a Wonderful Machine Your Watch Really Is? Imagine Yourself a Pigmy, Like the Characters In the Accompanying Story, and You Will be Astonished Indeed to Learn of the Marvelous Speed Attained by the Balance Wheel for Example, and the Number of Miles a Point on Its Rim Will Have Traveled in One Year—or Even a Month or a Week. Most Remarkable of All Is the Fact That the Average Watch Is Cleaned and Oiled But Once a Year or Less Frequently, and Still We Humans Expect This Marvelous Vest-Pocket Machine to Forget Friction and Wear, so as to Keep "Perfect Time" Year In and Year Out.

Visiting the Inside of a Watch

WE are all of course familiar with machinery, particularly with respect to the noise and whir of spinning pulleys and gear wheels in machine shops as well as locomotives, automobiles and various other commonplace mechanisms, which greet us daily on every hand. But did you ever stop to consider what a wonderful specimen of fine machine work you are carrying around on your person every day—I mean your watch or timepiece? Even in the dollar watch there is a refinement of mechanical precision and workmanship which is hardly approached in any other instrument used by man, or at least commonly by the public, for now, practically everyone carries a watch. Not only does the modern watch represent a beautiful piece of microscopic workmanship, but it is really astonishing, when we come to realize the intricate forces, which are constantly at work in our busy little timepiece, to which we pay attention only when it ceases to run or when we read the time indicated. The laws of mechanics as applied in the modern watch, if carried out proportionately in our larger machines, would spell instant disaster, for they would tear themselves to pieces trying to keep up with the watch.

Imagine yourself, in a dream, as a pigmy making a visit to the inside works of the modern watch. Long before you reach the towering metal structure housing the huge machinery, your

(*Continued on page* 270)

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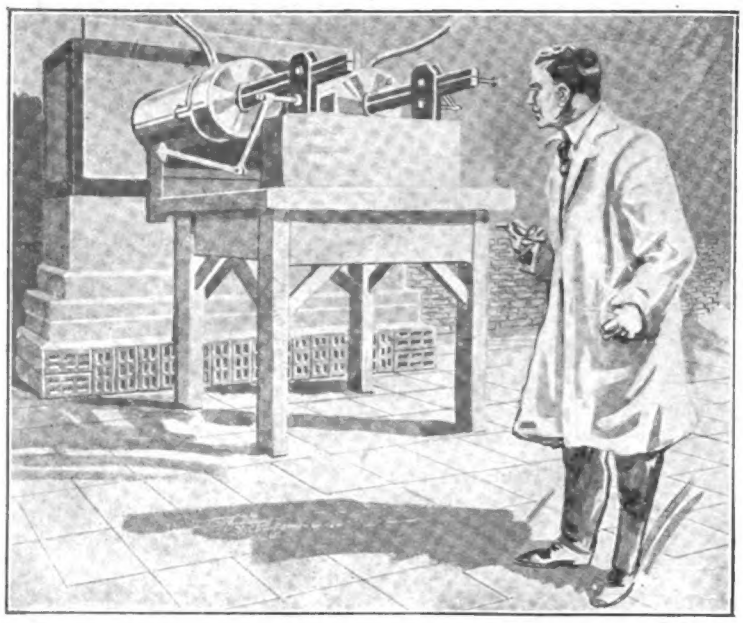
Diamonds From the Electric Furnace

By E. de BOISMENU



Four-Electrode Electric Furnace for Making Synthetic Diamonds. The Two Cathodes Are Adjustable by Hand In or Out of the Furnace. The Carbon Electrodes of Each Group Are Separated By a Space of 3.2 Inches.

How Diamonds 1/10 Inch in Diameter Were Successfully Made.

All attempts at the synthetic production of diamonds has sooner or later brought on active controversies of various intensity. Such was the experience of M. de Boismenu. Without wishing to take part in a question so much disputed, it appeared to us that an article on these sensational researches would be of great interest to our readers. We are greatly indebted to M. de Boismenu who gave us on his own responsibility in the following, the technique and the results of his experiments carried out in the privacy of his own Laboratory, as reported in La Science et La Vie, Paris, France.

CARBON is found in nature in various forms. In combination it enters into the composition of many gases (hydrocarbons, carbon monoxide, carbon dioxide) of liquids (petroleum) or of solids (carbonates such as limestone, dolomite, tissues of plants and of animals, etc.).

It forms the different subterranean combustibles found in black amorphous masses more or less stratified, going under the names of lignite, anthracite and bituminous coal.

Crystallized carbon is called grafite and diamond. The latter is of absolute purity; it is colorless and perfectly transparent.

Diamond is found in certain natural deposits principally in the East Indies, in South Africa and in Brazil.

Many attempts have been made to produce diamonds artificially, that is to say, as has been often said altho in improper phraseology, to realize the synthesis of the diamond. As a matter of convenience we will use this expression.

The synthesis of transparent crystallized carbon or in other words the manufacture of the diamond, whenever one dares to speak about it, excites astonishment and suspicious incredulity.

But there is nothing mysterious or miraculous or magical in this synthesis any more than in the commercial synthesis practiced today, of rubies, of saffires, of emeralds, of corundum, or in those of iron, copper, nickel, etc.

In 1772 Lavoisier burning the diamond in a flask filled with oxygen, found that the products of the combustion were exactly the same as those of the combustion of carbon.

This identity nevertheless was true and all the scientists of that epoch repeating this experiment, gave it a brilliant confirmation. Therefore, this marvelous stone, this fragrant of a star, as the poets call it, was nothing better than carbon, a piece of this common gross carbon, distributed with such great profusion in nature. Between the piece of opaque coal thrown disdainfully into the furnace and the splendid gem whose fires enhance the royal diadem, no kind of difference is to be found from the standpoint of internal constitution, except the different orientation of identical molecules; but in dethroning the king of the mineral world Lavoisier's discovery opened the new route, and if the synthesis of the diamond still seemed afar off, at least from this moment it was clear, that sooner or later the feat would be accomplisht.

Since the diamond is really nothing but carbon, the problem of its synthesis comes down to making this carbon pass from one of its forms, so varied and so common, to its crystallized form, so rare and so precious.

A great number of scientists attacked this entrancing problem, without finding its solution. One thing they lacked —this marvelous modern appliance which is termed "the electric furnace," invented by Siemens in 1879, which reduces, melts, volatilizes the most refractory body, and out of which Moissan has produced the synthesis of the diamond, which gave him his illustrious fame.

It is therefore, understood that carbon may have no apparent fusion, and that it passes from the solid to the gaseous state, without our being able to identify its passage thru a liquid state, but many scientists and Moissan himself believed that it could pass thru this state, and should be found in its combinations when these combinations themselves are liquefied.

Many metals such as iron, manganese, silver, and all the metals of the alkaline earths and the alkaline metals themselves (potassium, sodium, lithium, baryum, calcium, etc.) have the property of dissolving in high heat, greater or less quantities of carbon, forming carbides of iron, silver, sodium, etc.

Moreover for some of them at least, such as iron and silver, the quantity of carbon which they can dissolve, or their limit of saturation, grows greater as they are heated to a higher temperature.

For example melted iron, brought to a temperature of 2912° F. can dissolve about 3% of carbon, becoming cast iron. If the temperature is brought up to 3632° F. the limit of saturation increases so that this bath can dissolve 4% of carbon. If now we reduce the temperature to 2912° F. the limit of saturation will decrease, and the excess of carbon which it dissolved between 2912°

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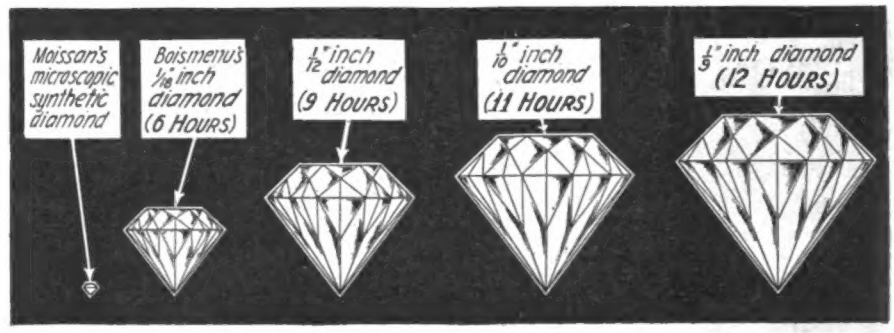
Moissan's microscopic synthetic diamond
Boismenu's 1/16 inch diamond (6 HOURS)
1/2 inch diamond (9 HOURS)
1/10 inch diamond (11 HOURS)
1/5 inch diamond (12 HOURS)

This Chart Shows, Magnified 10 Times, the Comparison Between the Original Moissan Electric Furnace Diamond and the Larger Specimens Made by M. de Boismenu. The Longer the Current Was Kept On, the Larger the Diamond.

These Eleven Stones, Made in Nine Hours, All Measured Over One-Twelfth Inch in Their Greatest Diameter. They Were Produced in the Electric Furnace, With a 700-Ampere Current and at a Potential of 32 Volts.

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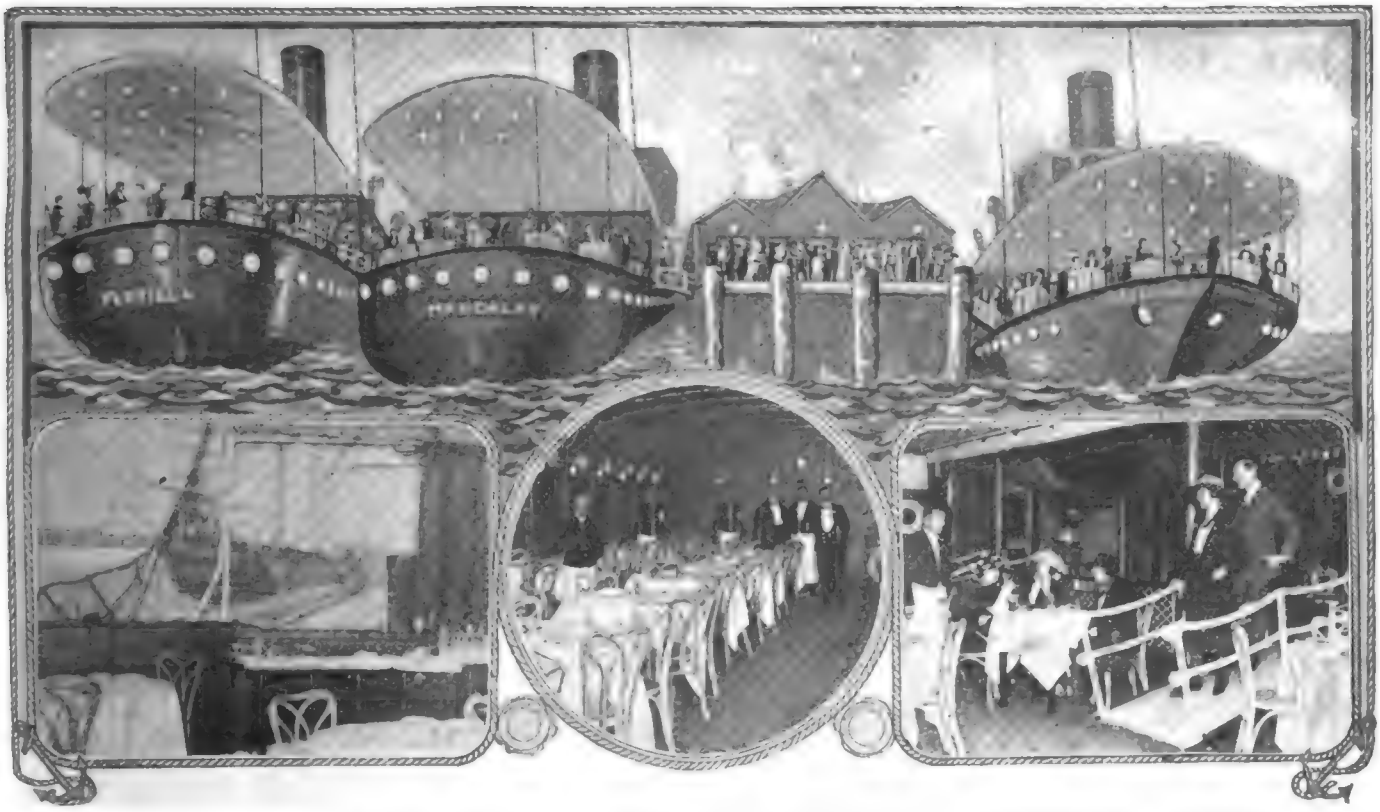

The Dry Land "Yacht" Restaurant Which Makes You Think You are on the Hudson While You Dine. The "Ships" are Anchored at the "Dock" in New York City; It Is the Enterprise of Dr. John A. Harriss. There are Three Yachts in This Restaurant Known as "The Irresistible," the "Flotilla" and the "Mandalay."

A Dry Land "Sea" Restaurant

IN New York City a unique restaurant is to be found, which cannot be excelled by any other place on the face of the globe. It was erected recently under the direct supervision of Dr. John A. Harriss in his building on 55th Street, and bears the name of The Flotilla. Up to the present time the cost of fitting up this restaurant has amounted to $1,300,000. On entering the building, one first feels a sense of extreme coolness, which is greatly appreciated in these warm summer days. The patrons then proceed up a gangplank to a sort of reception hall where a large number of models of sailing vessels, steamships and gondolas are in evidence. Some of these models cost as much as $800.00 and are perfect in every detail, many of them having great historical and antique values. Between two binnacles one descends to the deck of the good ship Mandalay. This is a large vessel outfitted so as to resemble a ship in every detail. At the rear of the room may be seen the ship's bell and clock and the usual nautical instruments. The roof is covered with canvas and the tables have upon them ship's lights in red, green and white colors.

Upon the tables, even the ash trays are made to resemble small sailing vessels in bronze. At the left a gangplank communicates with another ship and here and there portholes are open and the angry sea may be seen painted upon a canvas in the background. This latter vessel is built of solid mahogany and the sides have a curve identical with that found in large sea-going ships. Two railings separate the ships, and one ship is slightly lower than the other. Heavy ropes seemingly lash them together. Proceeding back in the other direction one comes upon the dock with its houses, life preservers and piles, ropes, colored lights and cleats, all in their proper location and each serving a definite purpose. A band is also found upon the dock, and on either end artificial waterfalls have been introduced to enhance the effect. Between the dock and the Mandalay real water may be seen, which body measures about one foot wide; it is constantly agitated by a motor and propeller located under one of the gangplanks. Cork floats are suspended here, the same as they naturally would be, if the ships were at sea.

At the far end of the dock a stairway leads to the most beautiful vessel of all, where even the bow of the vessel is in evidence. An anchor, a windlass, flags and poles may be noted. Further forward and all along the sides a panorama has been painted, resembling the ocean with hundreds of vessels upon it. Each painted vessel is complete in every detail. This deck likewise is covered with canvas and a ladder leads up to what is supposed to be the bridge, but in reality is used to house certain devices to give a more realistic effect to the scene. Here a rising and setting sun machine projects upon the background the sun in its varying positions. A wave machine creates the impression of moving waters. A cloud machine gives us the masses of cumulus clouds, which roll across the background. Seamen in middy costumes are everywhere in evidence, as are ship's officers and the time is struck out by the ship's clock—four bells and all is well. Even the cuisine has been so arranged that one can almost taste the tang of the salt water. It is plain to see that no effort or expense have been spared to make this restaurant the most perfect one of its kind.

Some of the "August" Features

"Black Lightning"—With remarkable photos of this little-known freak. By Ferdinand Ellerman, of the Mt. Wilson Solar Observatory.

Disease Microbes are Cultivated on Paper Money—Fully illustrated. By Jacques Boyer.

Bombing a Warship Guided by Radio. Illustrated and described in detail.

"The Red Vote"—A gripping scientific story. By Harold F. Richards.

The Amateur Magician—Professor Hargrave will be with us again. By Joseph H. Kraus.

Animals that have Rubber Heels. By Dr. Ernest Bade.

New French Daylight Stereopticon—With photos of the apparatus.

Electric locater for buried metal, such as boxes, pipes, et cetera with full detailed working drawings and photographs. By Victor H. Todd.

"Freak Phonographs." By H. Johnstone.

"Home Electrics"—Electro-magnets and the laws of magnetism explained for everybody. By G. L. Hoadley, M.E.

Special feature section of How-to-Make-it and Constructor Articles. Don't miss it!

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How Electrotypes Are Made

By H. WINFIELD SECOR

THE electrotype, used today so extensively in printing papers, magazines and books, is one of those little known products of commercial science, and even those people, who use and handle them every day, perhaps do not stop to think of all the processes and stages of electro-chemistry employed.

It may be well to consider for a moment the difference between the electrotype and the original photo-engraving or *cut*, as it is commonly called by those in the printing and editorial field. The original photo-engraving is made up in several ways; in general the method is based on the principle that the photograph or drawing is photographed upon a sensitized plate, and the image is then transferred to zinc or copper by photography and then etched with acids, etc. If a duplicate cut or impression was desired for distribution to several magazines for example, in which a certain advertisement is to appear, the initial cost of having one dozen original photo-engravings made would be considerable, not to mention the time required. By the process of electrotyping, a dozen duplicates or more of a photo-engraving can be made at reasonable cost and also in a minimum of time. Not only this, but even where one possesses the original metal photo-engraving and not the original wash drawing or photograph from which the cut was made, it is difficult in most cases to get a satisfactory duplicate of such a cut by pulling a proof of it and then re-photographing from this proof.

The First Stage of an Electrotype

The accompanying illustration shows the successive stages followed in the making of electrotypes, whether of line-cuts or half-tones. The original cut is first thoroly cleaned and an impression of this cut is made on wax, see Fig. 1. A metal slab is coated on one side with a layer of wax about ⅛" thick. Bees' wax was previously used, but now ozokerite is practically always used. The original cut is placed, type-face down, upon the wax in a hydraulic press, which forces the cut into the wax very firmly, so as to give a clean, sharply defined impression. The wax process is used mostly at the present time for reproducing line cuts and coarse screen half-tones. The finer screen half-tones, even those having as many as 200 dots to the inch, are very successfully electrotyped by taking the impression on thin sheet lead in a hydraulic press capable of exerting a pressure as high as 2,000 tons. All the fine dots and lines corresponding to the high lights and shadows are faithfully reproduced in the lead.

Preparing the "Impressions" for Electro-Plating

If the impression has been taken on lead then very little further preparation is necessary before suspending the lead plate in the electrolyte bath in which copper, nickel or iron is to be deposited on it, as shown in Fig. 3. The lead impression is treated with a solution, so that the deposited metal will not stick too tightly to its face.

Let us now go back to the wax impression. Referring to Fig. 2, we see how the impression in the wax is thoroly coated with grafite. This is one of the most important stages in the whole art of electrotypy, for if the grafite used is not the very finest manufactured and moreover if it is not thoroly dusted into the smallest crevices of the impression, the electro-deposited plating will not be perfect and, therefore, will be valueless. To insure the thoro coating with grafite, the wax impression contained on the metal carrier plate is past thru two different machines; the first machine seems to be doing the *shimmy* in fourteen directions all at once, and its duty is to shake and coax the grafite, finer than the finest flour, into all of the crevices of the impression. In the other ... the impression is passed thru a mac... in which grafite in suspension is p... dled over the impression automatically.

The electroplating department of any electrotyping plant is one of the most important of course. Today there are in general use three kinds of electrotypes—those made from copper, nickel and iron, the latter forming the so-called *steel-plated* electrotypes. The most common electrotypes now in use are the copper and the nickel; copper predominating. The iron faced elec-

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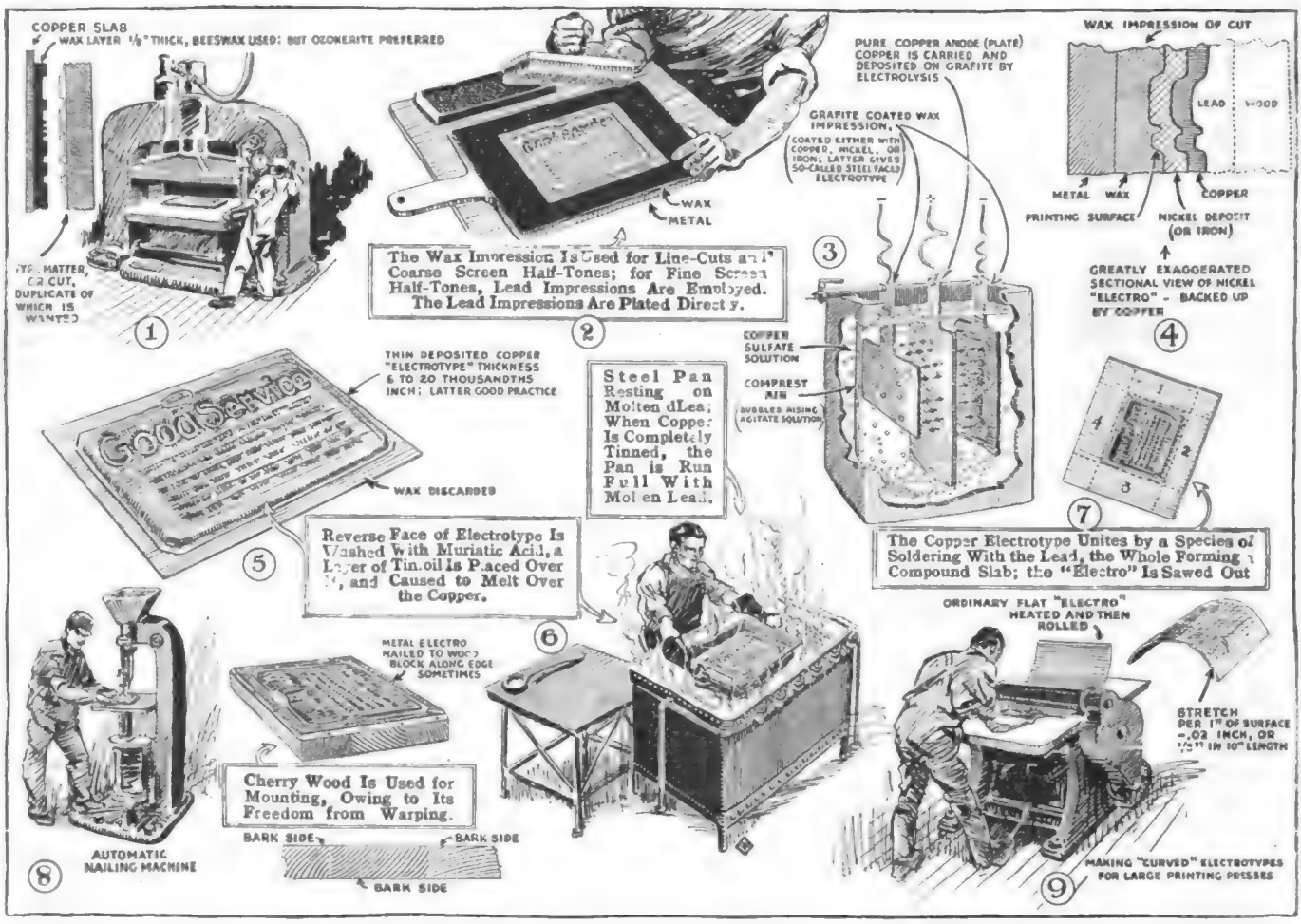
COPPER SLAB
WAX LAYER ⅛" THICK, BEESWAX USED; BUT OZOKERITE PREFERRED
TYPE MATTER, OR CUT, DUPLICATE OF WHICH IS WANTED
1
WAX
METAL
The Wax Impression Is Used for Line-Cuts and Coarse Screen Half-Tones; for Fine Screen Half-Tones, Lead Impressions Are Employed. The Lead Impressions Are Plated Direct y.
2
PURE COPPER ANODE (PLATE) COPPER IS CARRIED AND DEPOSITED ON GRAFITE BY ELECTROLYSIS
GRAFITE COATED WAX IMPRESSION.
(COATED EITHER WITH COPPER, NICKEL, OR IRON; LATTER GIVES SO-CALLED STEEL FACED ELECTROTYPE
COPPER SULFATE SOLUTION
COMPRESSED AIR
(BUBBLES MIXING AGITATE SOLUTION)
3
WAX IMPRESSION OF CUT
LEAD
WOOD
METAL
WAX
COPPER
PRINTING SURFACE
NICKEL DEPOSIT (OR IRON)
GREATLY EXAGGERATED SECTIONAL VIEW OF NICKEL "ELECTRO" - BACKED UP BY COPPER
4
THIN DEPOSITED COPPER "ELECTROTYPE" THICKNESS 6 TO 20 THOUSANDTHS INCH; LATTER GOOD PRACTICE
Good Service
WAX DISCARDED
5
Steel Pan Resting on Molten dLea; When Copper Is Completely Tinned, the Pan is Run Full With Molten Lead.
Reverse Face of Electrotype Is Washed With Muriatic Acid, a Layer of Tin.oil Is Placed Over It, and Caused to Melt Over the Copper.
6
The Copper Electrotype Unites by a Species of Soldering With the Lead, the Whole Forming a Compound Slab; the "Electro" Is Sawed Out
7
ORDINARY FLAT "ELECTRO" HEATED AND THEN ROLLED
STRETCH PER 1" OF SURFACE =.02 INCH, OR 1/50" IN 10" LENGTH
METAL ELECTRO NAILED TO WOOD BLOCK ALONG EDGE SOMETIMES
Cherry Wood Is Used for Mounting, Owing to Its Freedom from Warping.
BARK SIDE
BARK SIDE
BARK SIDE
AUTOMATIC NAILING MACHINE
8
MAKING "CURVED" ELECTROTYPES FOR LARGE PRINTING PRESSES
9

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IS THERE A SIXTH SENSE?

By JOSEPH H. KRAUS

HOW DO ANIMALS AND BIRDS FIND THEIR WAY HOME OVER LONG DISTANCES?

HAS not the question often arisen in your mind as to whether or not there really is a sense, other than the five senses, which latter have been the subjects of our recent series of articles, and have you not often wondered at what that so-called sixth sense is? We can without a doubt find traces of a super-sense amongst the animals, or perhaps we should call it an exaggerated faculty of using one sense to a greater extent than is possible for humans.

A North American Brown Bat and Its Huge Wing-Spread. Thruout the Wings and the Tail Nerves May Be Seen. In Addition the Wings Are Covered With Tiny Skin Ridges Which Are Undoubtedly Some of the Agencies Thru Which the Bat Is Enabled to Keep in Touch With His Surroundings Even Tho Blinded.

Utilizing our knowledge of the mental life in animals and of all their senses, of the powers of their instinct and of reactions performed without experience, and of the reactions which are built up thru experience, scientists and other observers have explained them all as being ordinary associative processes that aid in the abstract conceptional or inferential thinking.

Take for instance certain animals endowed with the marvelous homing instinct. We can lead them astray for many miles to find that a few finally return home. Thus for every hundred animals which we attempt to lead astray, 70 per cent of them will remain wandering thru the distant town and perhaps 10 out of the remaining 30 will return to their homes.

African Long-Eared Bat. This Bat Is the Only Long-Eared Bat, Which Flies Equally as Well in the Daytime as at Night. Note Particularly the Sensitive Hairs in the Ear, Which are Supposed to Give It Its Extraordinary Acuteness of Hearing.—Illustrations Courtesy American Museum Natural History, Congo Expedition.

Further — we could state that a dog perhaps notices a change in the atmosphere itself and then commences to wander in each of five or six directions and on finding that the air does not smell familiarly, he will retrace his path and start out again in an opposite direction. It has been proven that the dog's ability to smell is far more sensitive than the similar sense in man, and likewise that odors may travel immense distances. This is evidenced by the fact that sometimes we can smell a fire perhaps thirty to forty miles away and surely a dog could smell it further, but we must not here for one moment lose sight of the fact that a dog as well as other animals have quite an acute memory, as we shall presently see.

But in delving down into what we will term the sixth sense, we find that certain curious conditions prevail in the ordinary animal kingdoms; thus among bats we note a very peculiar power—particularly is it demonstrated when the bat is blinded.

Does A "Blinded" Bat See?

If a thin coating of shellac or a piece of plaster is placed over the bat's eyes so that the bat cannot see, and in addition to that, if the experiment is conducted in broad daylight, (as everyone knows a bat is practically blinded in the full light of day, or nearly so), the bat will fly around in a room all criss-crost with fine wires, the room being also prepared with a series of obstacles in scattered positions, and yet the bat will not strike or even brush against a thin wire or an obstacle. The room can be filled with mosquitos and the bat will devour every one and still not strike a wall nor touch anything in the room. Is this a sixth sense? It certainly is not an ordinary one, at least in degree; even tho we may accredit this power to an abnormal sense of touch we are unable to explain why the bat, with but very short hairs covering its body, will not hit a wall or any of the other obstacles placed in the room.

Some investigators claim that the manner in which a bat may travel thru a room without striking any obstacles depends on the fact that the bat emits soundwaves that are rather weak and also of a pitch too high for human ears. In other words the human auditory nerve cannot hear those sounds above a frequency of 35,000 vibrations per second, but the bat with its extraordinary sensitiveness, can hear all these sounds. Therefore when the bat is flying around a room in which objects and other hindrances have been placed, it continually emits this high vibratory note; this is reflected by the object and the bat hears the reflection, then it infers or it is thought that the bat co-relates the sound and its reflection, with distances to the object and changes its path and flight. Altho this explanation seems plausible, as we can see by the photographs of bats on this page which show the extraordinary ears which a bat possesses, there are many hitches and seeming flaws in the explanation. Thus for instance, the bat will not even as much as graze a thin silk thread strung across a room, which would hardly have enough surface or enough resiliency to cause a noticeable sound reflection. In the opinion of the writer it seems that not only sound reflection, but also an extraordinary sensitivity on the part of the skin and its appendages must be included. Thus a bat will, when flying across the bottom of a room come to a closed door and fly upward along its length and then across as tho following the smallest and scarcely perceptible air current, and yet the bat can creep thru a hole even with its eyes blinded when the hole is large enough for its body,

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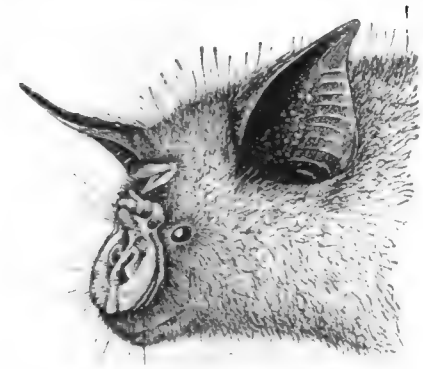
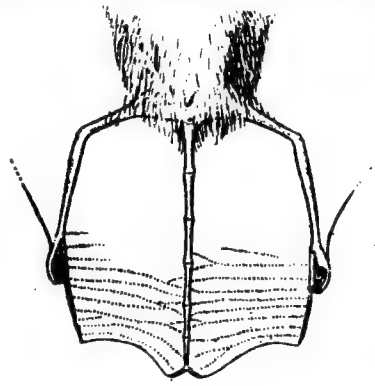


A Leaf-Nose African Bat. Note the Extraordinary Nose. The Peculiar Long Ears Are Covered With Small Projections Whereby the Sensitiveness of Sound Perception Is Greatly Augmented.



The Interfemoral Membrane in a Bat Has a Number of Longitudinal Stripes Which Sometime Branch. These Are Considered to be Nerves by Modern Scientists.

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The Group in the Picture Includes Madam Curie, Standing Between President and Mrs. Harding, and at Left, Mrs. William Brown Meloney, Editor of "The Delineator." The Latter was at the Head of the Committee Which Raised the Funds for the Radium Purchase.

The Gold Receptacle and Container for the Gram of Radium Presented to Madam Marie Curie by the Women of America. The Presentation was Made by President Harding at the White House, in Washington.

Madam Curie's Visit to America

By Dr. T. O'CONOR SLOANE, Ph.D., LL.D.

MADAM MARIE CURIE, of world wide fame as the discoverer of radium, is now in this country and is in almost daily receipt of the highest honors the colleges can give her. An extensive organization, for the collection of money for the purchasing of a gram of radium, to be presented to her, has succeeded in raising over $100,000 for the purpose, so that the great scientist now has the material with which to prosecute her work. This was presented to her in Washington at the White House by President Harding. Madam Curie proposes to devote her researches to the development of the cure of cancer by radium.

Radium occurs in very small quantities in some few minerals. It is a fortunate thing for humanity that it does occur in minute quantity, because in concentrated percentage it would be a disagreeable substance to deal with, as its emanations affect the human tissues disastrously. Their destructive action it is, that is used to fight cancer. The emanations act to destroy the infected tissue.

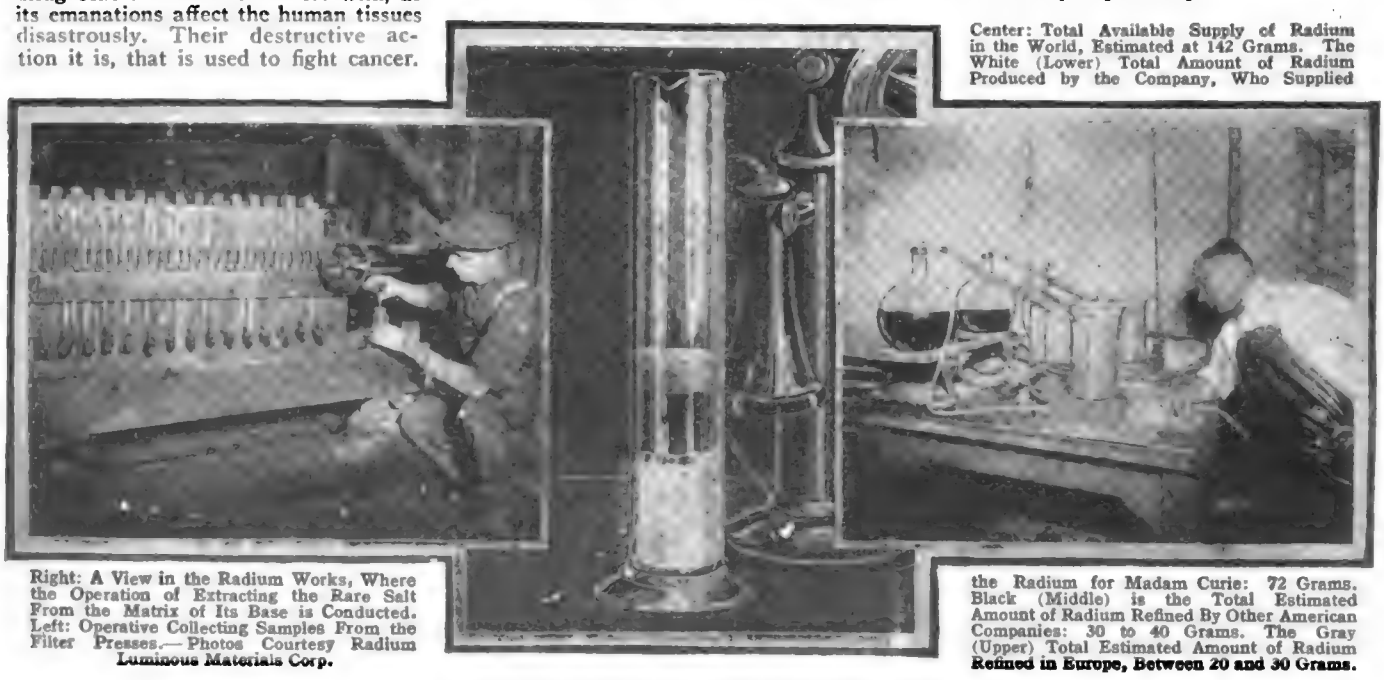
A couple of views in the radium factory are given and a graduate is shown which is supposed to demonstrate to the reader the total estimated available supply of radium in the world. America, as will be seen is far ahead of Europe in the amount produced.

The group shown in one of our cuts includes Madam Curie standing between President and Mrs. Harding, and to the extreme left is Mrs. William Brown Meloney editor of our well known contemporary, The Delineator. This lady is largely responsible for the initiation and great success of the subscription for the gram of radium.

The receptacles for containing the gram of radium are shown in one of our cuts. The object of these enclosures is to prevent the powerful emanations from injuring anyone who might be carrying the material with him. There have been several slow and lingering deaths brought about by X-rays. Especially was this the case with the earlier operators, for in the first days of its history, the danger of prolonged exposure to the un-shielded X-ray tube was not known, and even a few years later, when it was realized, inadequate ways of protection from its effect did comparatively little at first to improve the situation.

In the case of radium a full knowledge of its dangers and the development of protective enclosures for it have moved side by side.

It is told of one of the early workers, that he got quite a serious burn by carrying some inadequately protected radium salt in his pocket. The burns are somewhat of the nature of intensified sunburn, and are comparable, in a degree, to those produced by ultra-violet light, as it emanates from quartz tube mercury vapor lamps.



Right: A View in the Radium Works, Where the Operation of Extracting the Rare Salt From the Matrix of Its Base is Conducted. Left: Operative Collecting Samples From the Filter Presses.—Photos Courtesy Radium Luminous Materials Corp.

Center: Total Available Supply of Radium in the World, Estimated at 142 Grams. The White (Lower) Total Amount of Radium Produced by the Company, Who Supplied the Radium for Madam Curie: 72 Grams. Black (Middle) is the Total Estimated Amount of Radium Refined By Other American Companies: 30 to 40 Grams. The Gray (Upper) Total Estimated Amount of Radium Refined in Europe, Between 20 and 30 Grams.

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Fortunes From Little Things

By CHARLES FREDERICK CARTER

The Rubber Heel

BARRING unforeseen eventualities, it is estimated that 150,000,000 pairs of rubber heels will be manufactured in the United States in 1921. Last year we had to skimp along on a beggarly 125,000 000; but then times were rather hard, as you may have heard.

A good many concerns are engaged in the manufacture of rubber heels, or think they are, but the great bulk of the trade is securely corralled by the —Well, really, after all these years, must I identify it by name?

The Gentleman Shown in the Center Oval Is None Other Than Mr. Humphrey O'Sullivan, Inventor of the Rubber Heel Made Nationally Famous by Extensive Advertising and Usage. Mr. **O'Sullivan Improved and Extended the Sale of His Rubber Heel so Successfully That It Has Made a Fortune for Him.**

Diagram at the Left Shows How the O'Sullivan Rubber Heel Is Firmly Secured to the Leather Heel of a Shoe, by Cementing and Nailing. Above We See How the Rubber Heel Absorbs the **Mechanical Shock Encountered in Walking, Particularly When the Heel Strikes a City Pavement or Other Hard Surface.**

This is because this particular heel was devised, brought out and nursed and tended by a genius. He is no longer interested except as a stockholder. After twelve years of the strenuous life, trying to keep step with the enormous business he had created, it reached the point where he had to hire a man to shovel the money away from his door, so he could get out in the morning—at least, so they say. He finally thought it was about time to quit. Since then he has been adding to his reputation as one of the foremost citizens of Lowell, Mass.

Humphrey O'Sullivan did not invent the rubber heel premeditatedly and with malice aforethought. He had been keeping an eye out for years for something he could sell, not to a neighborhood, but to the world. If it had been a safety razor or a sulky plow it would have been all the same to him. It just happened to be rubber heels.

You see Humphrey O'Sullivan is an Irishman, and a County Cork Irishman, at that. He graduated at the National Schools and made a specialty of voice culture and oratory, winning several prizes for his eloquence. Note this, for you will soon see how his mastery of the English language became an important factor in his success.

O'Sullivan landed in New York in 1874 when he was just 21, determined to get rich without unnecessary delay, although he had no capital except a fair knowledge of the printers' trade. Finding after three years' labor at the case, that his bank account had not increased alarmingly, he went to Lowell, Mass., and joined his brother Jim in a shoe store, their joint capital being $1,300. They allowed themselves each a salary of $15 a week, plus 50 cents to be squandered in riotous living. They were very hard bosses for themselves, never allowing themselves a raise for 21 years, altho both had married meanwhile. At the end of that time they had the finest store in Lowell with a stock worth $45,000 clear of incumbrance and $25,000 invested in real estate.

Jim was satisfied, but Humphrey wasn't. The article he was looking for to sell alike to the nobility of England, the free born citizens of America, and the more advanced of the inhabitants of the Fiji Islands had not appeared.

One day he heard that a firm in Boston was making shoes with rubber heels. He boarded the first train for Boston, and tried to obtain the Lowell agency, but a competitor had got ahead of him. Humphrey bought one pair for himself and went home to study those heels. They were thick and heavy and hard and held in place by screws. After one consecutive day's wear the rubber was rubbed off down to the screws, so that the wearer walked on the screws and not on the rubber.

"I can beat that with one hand tied," said Humphrey. Suiting action to word he sketched a rubber heel to be held in place by five nails with washers countersunk deeply, to keep the rubber from ripping off the nails. Then he went down to Boston again and arranged with the Boston Belting Company to make up a suitable compound of rubber with the proper resilience, toughness and durability. After that, in 1899, he secured a patent on his invention.

He wanted to start in business in the store with Brother Jim. But Jim could see nothing in rubber heels. So Humphrey moved into another building and started in alone. You see he couldn't get any one to work for him. What! Give up a steady job to work a few weeks for a Nut who thinks he can sell rubber heels?

Right away Humphrey adopted the policy which has so endeared him to the American publishers. He advertised and advertised big. By the end of the first year, playing practically alone hand he had cleaned up $32,000 net profit.

Fame has its drawbacks, as O'Sullivan found, when an Englishman who had taken out a patent on rubber heels, but had never manufactured any, tried to interfere with his business.

"Damn the patents! Go ahead!" said O'Sullivan, paraphrasing Admiral Farragut. After that he never mentioned patents but advertised O'Sullivan's heels.

After the first year's success bookkeepers and others would condescend to work for O'Sullivan. He even found a partner, J. Munn Andrews, who took twelve twenty-fifths of the business off his hands for $12,000. But would you believe it? Andrews got cold feet and repeatedly asked O'Sullivan to take back his old stock. Jim knew a good thing when he saw it, so he attended strictly to the shoe store, although he had a fourth interest in the rubber heels, leaving Humphrey to ruin himself if he wanted to.

O'Sullivan adopted the eight-hour system for himself—eight hours twice a day. He knew that shoe dealers and cobblers would not be amenable to reason, so he paid no attention to them but set out to sell his idea to the shoe-wearing public, realizing that of course the dealers would have to meet the demand. At first the heels sold for 75 cents attached, but O'Sullivan knew that was more than they were worth. To oblige dealers to keep the price down to 50 cents he advertised the rate and thus kept the matter under control.

Soon after he started business, the Goodrich Rubber Company, of Akron, Ohio, came to him with a formula for a better compound. O'Sullivan made it still better by adding 10 per cent more pure new rubber. The compound is a secret which makes the O'Sullivan heel so different from all others. On that secret the enduring success of the invention has been built; for no article, no matter how fervently boomed can retain favor long, if it hasn't solid merit. The heels are still made in the Goodrich factory, which has been enlarged again and again to accommodate those troublesome heels until it is now said to be one

(*Continued on page* 263)

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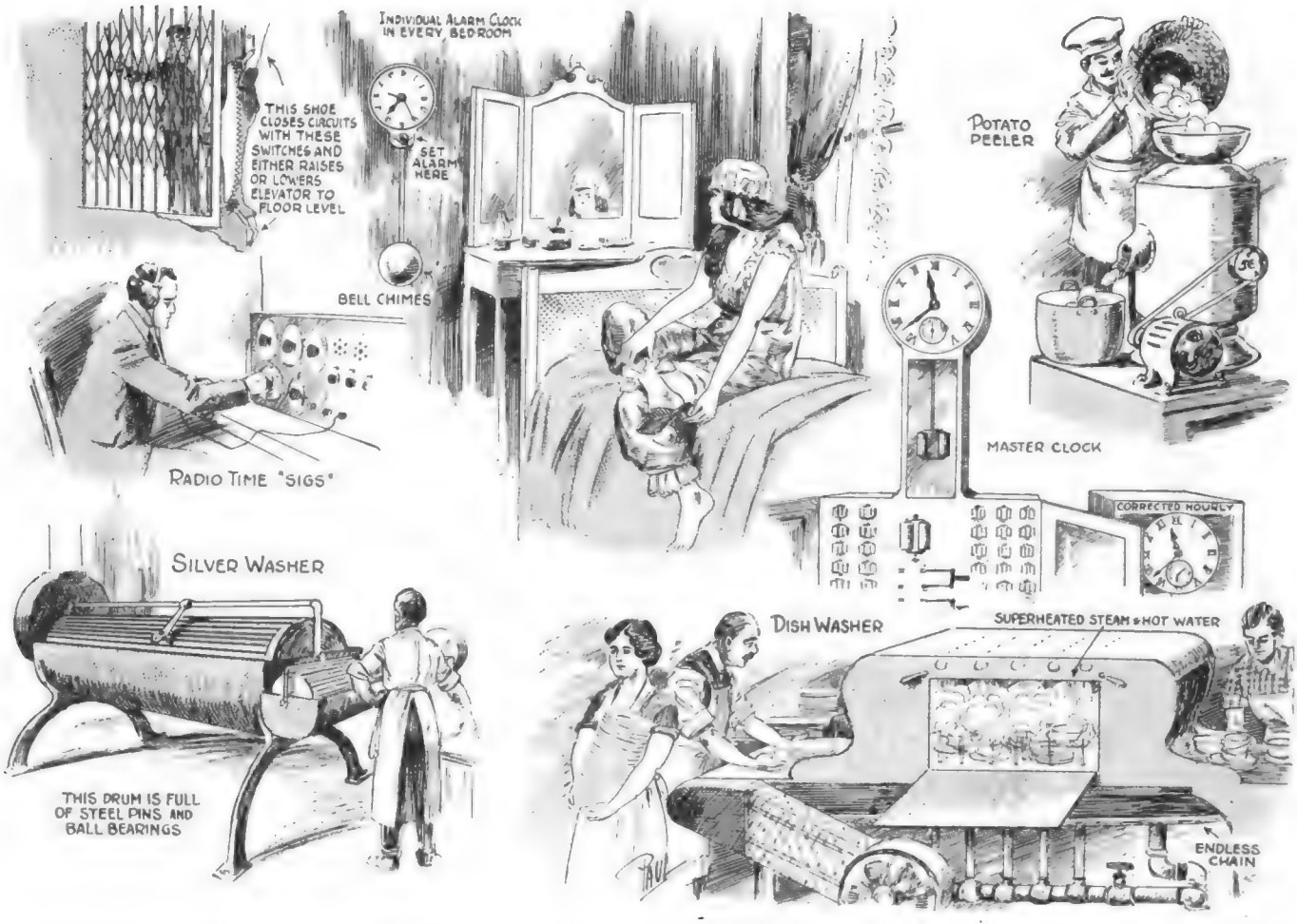
The Commodore—Prince of Hotels


INDIVIDUAL ALARM CLOCK IN EVERY BEDROOM
THIS SHOE CLOSES CIRCUITS WITH THESE SWITCHES AND EITHER RAISES OR LOWERS ELEVATOR TO FLOOR LEVEL
SET ALARM HERE
BELL CHIMES
RADIO TIME "SIGS"
POTATO PEELER
MASTER CLOCK
CORRECTED HOURLY
SILVER WASHER
THIS DRUM IS FULL OF STEEL PINS AND BALL BEARINGS
DISH WASHER
SUPERHEATED STEAM & HOT WATER
ENDLESS CHAIN

New York's Newest Hotel, The Commodore, Has a Host of New Scientific Ideas to Show Its Guests. For One Thing the Electric Elevators Stop at the Exact Floor Level and Not One Half Foot Above or Below. An Electric Chime Alarm Clock, Giving Correct Time "via Radio," Appears in Each Guest's Room. The Electrical and Other Machinery Provided in the Kitchens and Various Departments Represent the Very Latest Ideas, and There is No Such Thing as Drying the Dishes, Peeling the Potatoes, or Cleaning the Silverware by Hand—Machinery Plus Electricity Does it All.

ONE of the most beautiful hotels in New York, the Commodore, has incorporated ideas which are the acme of perfection in hotel design. Take for instance the electric elevators. These are so arranged that should the operator decide to stop at the seventh floor, the elevator cab does not stop one foot above the floor level and then glide down to a foot below and finally, after much undulation, come to its position. On the contrary; if the elevator slips by the floor a contact shoe automatically closes a circuit, which operates a secondary motor and the elevator is gradually brought to a position exactly on a level with the floor landing.

The rooms, each and everyone of which are fitted up differently, have electric clocks installed, whereby it is not necessary to announce the time when one intends to arise. The guest walks over to the clock and sets it and then retires, and in the morning a pleasing chime awakens the slumberer. These clocks are absolutely correct and are operated by a master clock in the subbasement, which closes the circuits thru a series of relays, and thus give accurate time. Should the clock stop for any reason, the master relay will automatically reset the clock, and here radio time signals are obtained by the operator at 12:00 noon and 10:00 p.m. Eastern Standard time, as transmitted from the Arlington station. There is also a Western Union clock with its *corrected hourly* sign upon it, which enables the operator to keep his master clock correct up to the second. Several novel innovations appear in the kitchen, where we find large drums for cleaning the silverware, which revolve, shaking the silverware around amongst steel pins and ball bearings, and polishing it at the same time.

Superheated steam automatically washes the dishes, and they come out practically dry and need but slight polishing to give them their luster. Soup is boiled in gigantic copper pots; the gas ranges are of the latest improved type; in them the gas heats clay balls to incandescence. Potato peelers capable of taking care of a whole barrel of potatoes at a time relieve the cooks of this unpopular labor. A candy kitchen is also provided wherein all kinds of delicacies, in the shape of dolls, roses and flowers and many other forms, are made.

$$\frac{2-\overline{90}/-(10)-690^2}{1-60^*-\sqrt{\underline{90}}}$$

A GERMAN architect, Herr Tiemer, has invented a universal language of absolutely astonishing simplicity. The question here is not of a universal language in the strict sense of the word, for example, such as Volapük or Esperanto, but the idea is to supply a method of comprehension, which presents for every language the advantage, that there is no troublesome study or learning of it required.

"Timerio," as this inventor tells the interested public, is based on the fact that all conceptions among all civilized races are the same. It is only the way of expressing them that varies. If you can give then, to each conception an international form of expression, it will be understood everywhere. The simplest form of expression of this type consists in the Arabic numerals. For instance, instead of the conception "I," we can use the figure 1. Instead of "you" we can use the figure 2. Now for "write" we can take the number 30 and for "letter" the number 980. Then if we have the series of numbers, 1-30-980, they will indicate "I write a letter." The mere putting of these numbers in succession is not sufficient. The system must be flexible; like all languages, it must have its grammar. Therefore, to express the past, the number is underscored; thus $\underline{30}$ means "wrote." The future tense can have a stroke placed over the number, thus $\overline{30}$ means "will write." The plural is expressed by an exponential 2, thus 980^2, means "letters." A noun can be declined for instance:

6215 the father
6215II of the father
6215III to the father.

Adjectives can also be compared:

(*Continued on page 255*)

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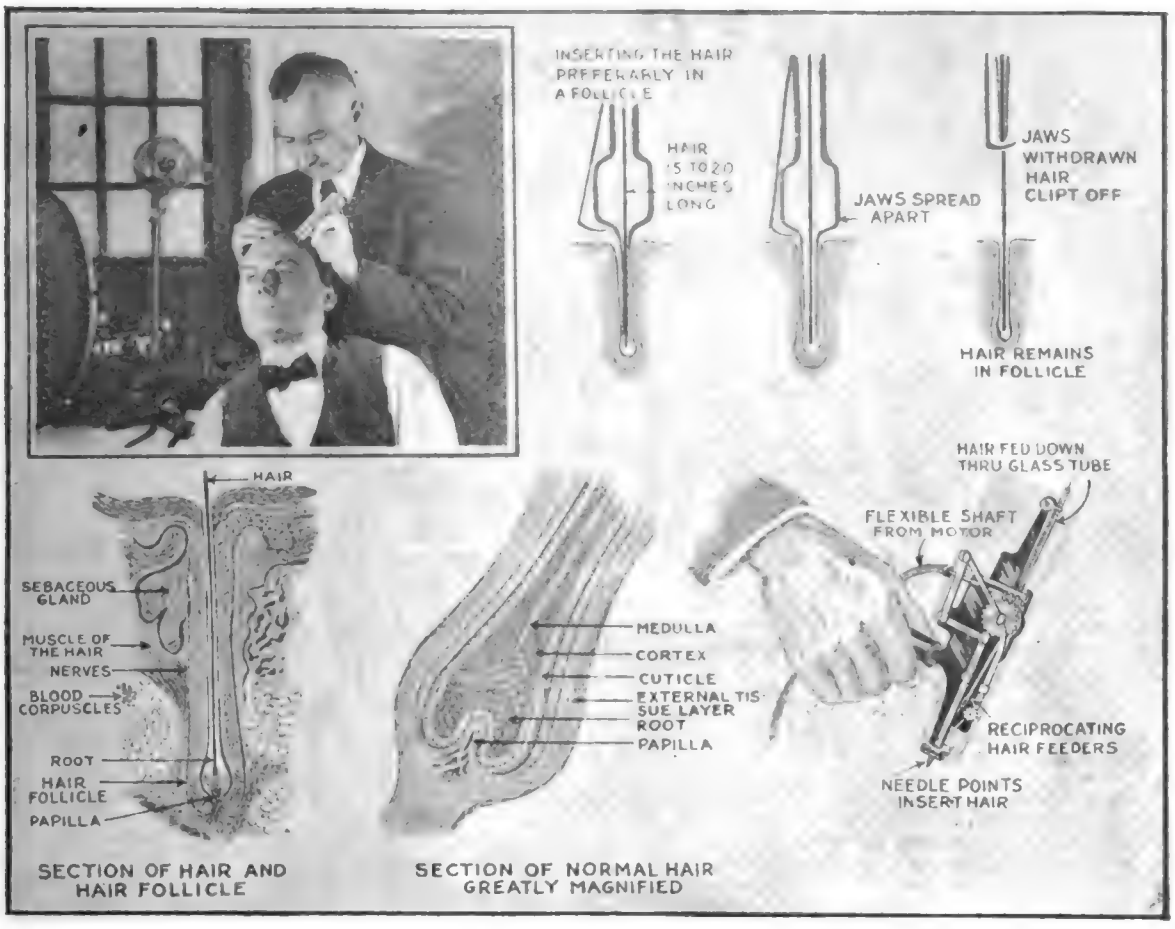
Why Be Bald?

By JOSEPH H. KRAUS

HAVE you ever heard of grafting hair upon a bald person's head, or in fact anywhere else where a natural fuzz, such as that which sometimes ornaments the upper lip is desired? No? Well, this is done today by the eminent physician, Dr. Parsegan, of New York City. His experiments have extended over a period of many years, and he has now demonstrated by grafting some hair on his own head, as well as convinced several members of the Bald Head Club, that such a thing is indeed possible. Dr. Parsegan has shown us quite a tuft of hair, which he has grafted into his own head, saying, as he tugged at the tuft with considerable force, "You see I believe in tory operations, X-Ray, ultra-violet light and massage treatments he stimulates the scalp in every manner known to the modern scientist (and we may add here that Dr. Parsegan is not a backward doctor by any means, as his office is well supplied with high frequency apparatus and all other up-to-date therapeutic apparatus). After this treatment Dr. Parsegan inserts into a small machine a long female hair, not because the female hair grows better on a man's head, but it is rather difficult to find a man with hair 18 to 20 inches long. He then goes over the scalp with the aid of a magnifying glass and the instrument and presses a tiny button whereupon the following operation within the tissue and a knife cuts the hair off short. He then proceeds to another location and if possible plants the hair into a follicle. The root of the hair is not planted into the scalp. Dr. Parsegan has noted that when a black hair is planted upon a blond man's head, if the hair succeeds in growing, it becomes blond; but even should he be unsuccessful in making the hair grow on every person, the toupee which this method furnishes could readily take place of those now in use. The scalp could be washed just as any other head of hair could be washed and the toupee would not be removed whenever a man's hat is taken off. We would not



The First Practical Operation for Grafting Hair on a Bald Head by a Process Just Perfected by Dr. J. S. Parsegan, the Prominent New York Doctor; it Was Performed at the Annual Banquet of the Baldhead Club of America at Torrington, Conn. The Doctor Ingrafts Upon the Head of Each of the Subjects a Half Dozen of Healthy Hairs Plucked from the Heads of Beautiful and Healthy Maidens and Specially Prepared for Plantation, Either Blond or Brunette as Desired.

Insert Photo © Kadel & Herbert

playing the goat myself. As the old adage goes, try it on the dog first. I have consented to be the dog and the result is quite startling."

Dr. Parsegan's method is quite interesting. He first treats the scalp so as to encourage the growth of hair should any capillary growth start. By vibra- takes place: Two lances force their way into the scalp carrying between their jaws a section of the female hair. The method of operation is very similar to that employed by the mosquito when it inserts its spears (at least they feel that way) into the skin of man. The jaws then spread slightly, leaving the hair have to chase his wig down the street in the event that a gust of wind had decided to relieve him of his priceless treasure. It is believed that the hair thus implanted has a tendency to restimulate the follicles which have remained dormant for a long time.

Copper, Lead and Iron Hardened at Last

An inventor recently called on the editors and showed them some very remarkable specimens of pure copper, pure lead and cast iron, which he had hardened till they were like steel. The inventor of this process which has frequently and popularly been called, "The Lost Art" of the ancient metal workers, is Mr. H. W. Hoops, of Montclair, N. J. Mr. Hoops, who is a well-known American chemist, explained that he had spent the best part of his life studying this enthralling subject of how to harden copper, and when he had found the chemical process for accomplishing this result, he naturally thought of the idea of trying to harden lead. The experiment proved successful and the sample of hardened lead, which Mr. Hoops showed the editors, was thoroly satisfactory in every way. It has long been desired for many different processes and industrial employments to be able to harden cast or wrought iron. It has been possible to chill cast iron or also to case-harden wrought iron with potassium cyanid and there are other methods of improving the quality of cast iron such as by toughening it, this result being known as malleable iron, but this is a very slow process and the iron has to be kept at a low heat in charcoal and cinders, for a period of several weeks, and it is not much tougher on the average than the iron in its original state. Mr. Hoops, therefore, seems to have discovered a hitherto impossible valuable chemical process, which has a very extensive field of application open before it.

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Soaring Like the Bird

By DR. ALFRED GRADENWITZ

THE development of the flying machine has not been a normal process: When, at the outbreak of war, military considerations made the immediate design of suitable types of air-craft imperative, the speed had to be raised by an excessive increase of motive power, which at the same time, tho at an expense inadmissible in normal times, insured a moderate degree of safety. From an economical point of view, the modern airplane therefore is most unsatisfactory, the performance of even the best machines entailing a relative consumption of energy, many times higher than the flight of any bird. Whereas an airplane of, say, 8,800 lbs. weight requires an expenditure of about 200 HP., that is to say, about .05 HP., per kg. (2.2 lbs.), to be kept flying in the air, the heaviest flying bird, the albatross, if increased to the same size, would only need 10 HP., the stork only 2 HP., the swallow 1-3 HP., the fly 1-16 HP., and the gnat (likewise increased to the size of a giant airplane) only 1-200 HP., to lift its body. This strikingly illustrates the inefficiency of man-built flying-machines, as compared with Dame Nature's own solutions of the flying problem.

The Nimführ Soaring Airplane

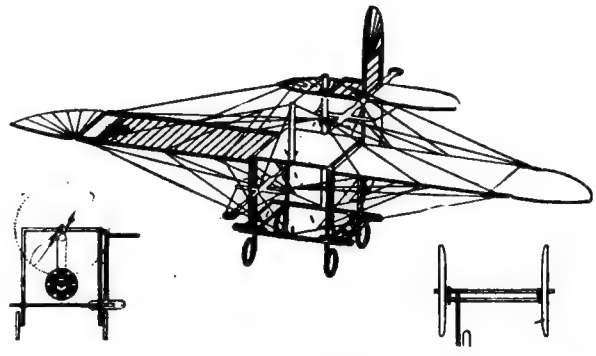
Dr. R. Nimführ, of Vienna, has investigated the cause of this inadequacy and has come to the conclusion that the present airplane theory is mainly responsible for it. In fact, the atmospheric air where the flying machine is moving, had so far for the sake of simplicity, been considered as a liquid rather than as a gaseous fluid, so that the "hydrodynamical" laws underlying ship construction could immediately be applied to the designing of airplanes. Nimführ therefore proposes substituting for the present theory an "aerodynamical" theory, where the cohesion and compressibility of air are fully taken into account. The rigid and immovable supporting planes of the present airplane are replaced by adjustable and elastic wings comparable with those of birds, and by fitting these wings with sensitive automatic gauges, a soaring flight is supposed to be made possible. Inasmuch as the motor may thus be braked or stopt temporarily, a considerable saving of energy is obviously obtained. In the classic rigid-wing airplane, where the lifting power is dependent upon the flying speed, soaring was only possible above a certain minimum speed, and the airplane, in order to rise, required a rather considerable starting distance. In Dr. Nimführ's airplane, on the other hand, with its quickly flapping wings, soaring is possible even at very low flying speeds, and rising from a very short starting course, that is to say, on a narrowly limited ground.

The New Airplane Designed by Dr. Raimund Nimführ. These Views Show the Upper and Lower Surfaces of the Plane and a Comprehensive Side View. Here the Rigid Planes Are Replaced by Elastic Wings.

The Soaring Airplane mainly comprises two carrying wings and two propellers. In spite of this apparent similarity of design, there is, however, a radical intrinsic (as it were, "physiological") difference in the design and efficiency of the various organs.

Whereas the flying bird, having lost its balance, is brought back into it instinctively, by the working of what has been termed a "sixth sense," the flyer, tho not devoid of a sense of equilibrium, had so far to rely for the stabilization of his machine on the intelligent, non-automatic control of a steering device.

In the Nimführ airplane, this control is effected automatically by a stabilizer entirely independent of the relative speed between the machine and the atmosphere; it is, as it were, some sort of mechanical brain, where mere disturbances of balance will set the proper steering levers working. The pilot has nothing else to do but to steer his horizontal course like the motor-car driver on the ground. Should he happen to faint or otherwise lose control of his machine, the latter would automatically continue its horizontal course, as long as the engine is working, in order afterwards smoothly to land in a gliding flight.



The Diagram Shows the Lay-out of the Machine Which Is Said to Fly With Minimum Expenditure of Power by Wing-jerks as Well as by Planing Action.

The Stabilizer comprises an Equilibrium Gage, any disturbance of which in any one of the three directions will actuate or stop an auxiliary motor thus w[illegible] corresponding steering devi[illegible] the various steering devices will control the rotation of the supporting (carrying) and tail surfaces as well as the length of the wings and tail (by an arrangement allowing them to be rolled up), the same as a flying bird will fold up its soaring sails, thus controlling their size. This is made possible by providing hollow wings designed to be blown up and the length of which, by the action of compressed air, can be increased as desired. By this admirable arrangement, the soaring capacity of the airplane is manifolded and the old problem of rising without any start and landing without any run-out is solved and a source of considerable danger removed.

The two propellers are only auxiliary organs, being used, e. g., in rapidly rising from the ground. The driving agent proper is derived from differences in atmospheric tension produced by periodical jerks on the mass of air below the wings. In fact, according to an hypothesis for the first time enunciated by Prof. Exner, of Vienna, the soaring of birds is based on a rapid flapping motion of the wings, which, tho being imperceptible already at relatively short distances, sets up waves of atmospheric pressure affording a sufficient support to the flying bird (or insect). Dr. Nimführ in a similar manner causes the airbag of his hollow wing to set the air vibrating by alternately blowing up and drawing in the pneumatic carrying surface which at its underside is closed by some sort of membrane. A pulsating wing such as this would in the case of an air-stroke wave-length of, say, 1 meter, with a load on the wing of 31 lbs. per square meter, generate a lift of 528 lbs., for each horsepower of the motor. A modern biplane would thus only require 10 H. P.

Soaring flights of considerable length have already been obtained in connection with trials on small-size machines, and recent tests on large wings have brought out the possibility of applying the same principle to huge machines.

The Nimführ airplane provides an even higher degree of safety than that of the railway or automobile.

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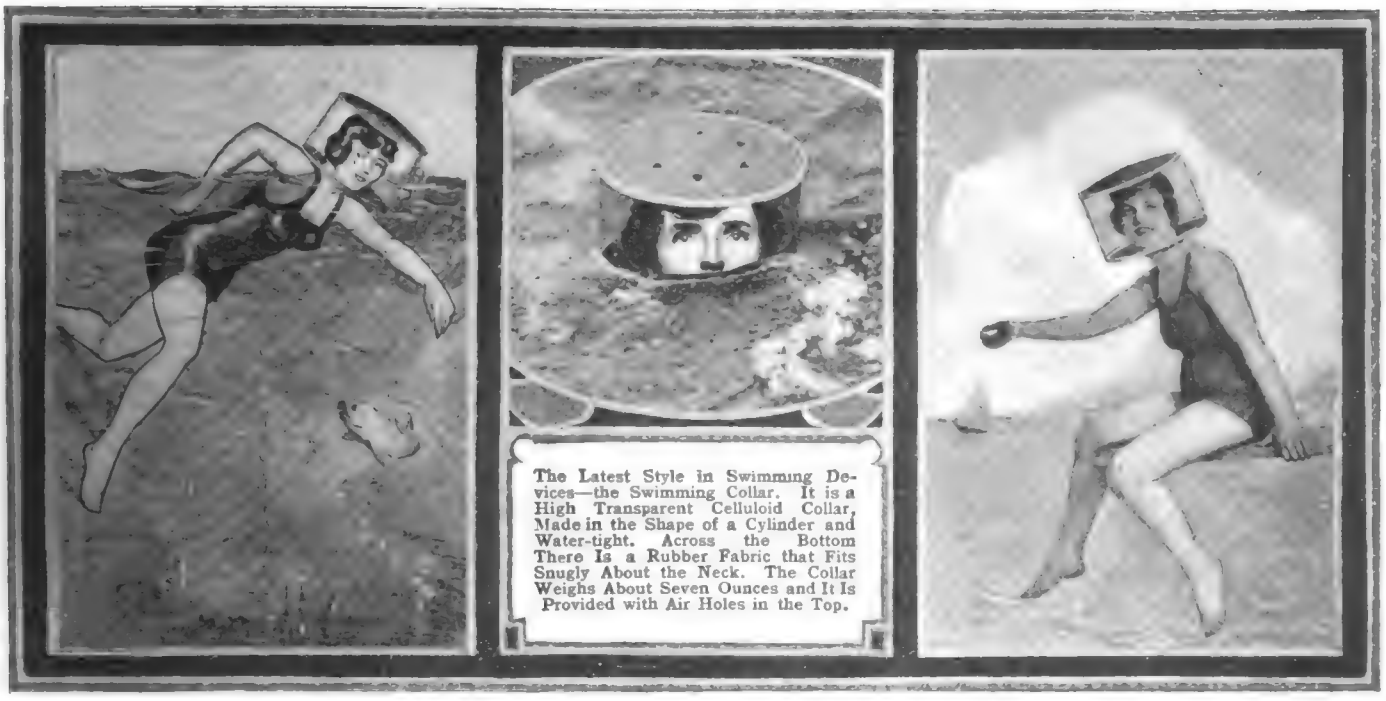
The Swimming Collar

By MRS. J. B. FLOWERS



The Latest Style in Swimming Devices—the Swimming Collar. It is a High Transparent Celluloid Collar, Made in the Shape of a Cylinder and Water-tight. Across the Bottom There Is a Rubber Fabric that Fits Snugly About the Neck. The Collar Weighs About Seven Ounces and It Is Provided with Air Holes in the Top.

MANY times has one said, "I wish I could swim, but every time I try, my head goes under water, I then get frightened and all my hopes of ever learning vanish." At last this great disadvantage, "head going under water" has been done away with, for recently a new device called the Swimming Collar has been invented.

It is a high, transparent, celluloid, cylinder-shaped collar, made water-tight across the bottom by rubberized fabric that fits snugly about the neck. The Collar is very light, it weighing but 7 ounces, and floats like a cork upon the water. It lifts the head, when in the water, with a buoyancy of about ten pounds, therefore keeping the head from sinking, and since the top of the collar is partly open to the air, because of its breathing holes, the swimmer can breathe freely.

It is truly a wonderful thing, for never before has there been a simple convenient device available, which would support the head, thus keeping the hair dry, and at the same time prevent water entering the beginner's eyes, nose and mouth. When using the Swimming Collar, a beginner can learn to swim the first time he or she goes into the water, for since the head is held up out of the water and all water kept away from eyes, nose, and mouth, he or she becomes self-confident and ventures forth into the deep without any hesitation or fear. I have seen small children put on a Swimming Collar and swim off as tho they were old at the art. It is indeed pleasant for women to use, for it keeps the hair dry, something the bathing cap never has succeeded in doing.

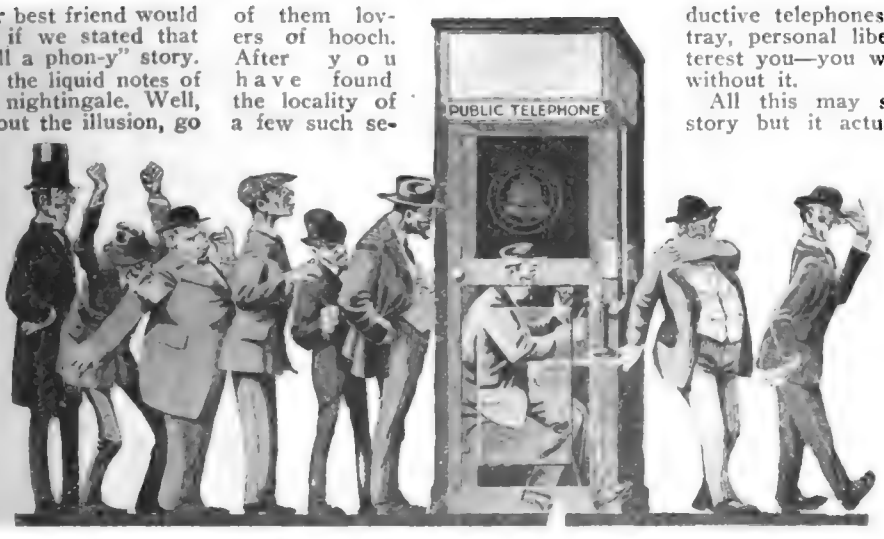
Swimming is a very popular sport of the American people. It is such a perfect form of exercise, that every muscle is brought into play and equal development is assured. This is one reason for its popularity with women, making her more graceful and rounded but up to the present time there have been so many disadvantages in trying to learn to swim that not nearly so many have enjoyed this great sport as otherwise would have. But the coming of the swimming collar has dispensed with all discomfiture, and now the timid as well as the brave can dive forth into the cooling waters and enjoy this greatest of all sports—*SWIMMING.*

The Telephone as a Bootlegger!!

We suppose that our best friend would cut our acquaintance if we stated that we were going to "tell a phon-y" story. We have all heard of the liquid notes of the skylark and of the nightingale. Well, if you want to carry out the illusion, go on a lark that is sky-high, and make your night on Broadway a perfect gale and indulge in liquids also, our artist shows you how. You want to get in front of a telephone deceiver; look into the face of a receiver converted into a transmitter, put your half dollar in the slot, and Oh Boy!

Next Independence Day there is to be a parade of the unterrified lovers of personal freedom and some of them lovers of hooch. After you have found the locality of a few such seductive telephones, as the one we portray, personal liberty will cease to interest you—you will have all you want without it.

All this may sound like a phoney story but it actually happened a few weeks ago in a New York saloon. It worked as follows: The thirsty customer who was wise to the game, walked up to the bar and slipt the bartender a good American greenback. The bartender then slipt the thirsty one a nickel and a cup; he then got in line with the other would-be telephone users. When his turn came we learn that he deposited the nickel in a slot device, turned the knob and Oh Boy!



Obtaining "Three-Star Hennessy" from a Telephone May Sound Almost Impossible, but Here's How It Actually Happened. The Thirsty Customer Slipt the Bartender a Greenback and He Received in Exchange a Cup and a Nickel. Being Wise He Enters the Innocent-Looking Telephone Booth, Places the Nickel in the Slot Device and Turns the Knob. Your Imagination Gives the Answer—if Not, Note the Two Gentlemen at the Right.

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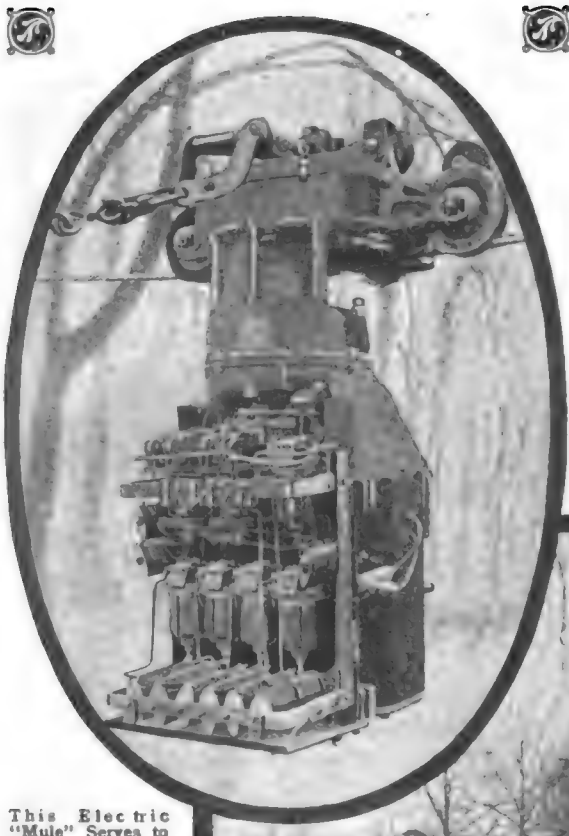
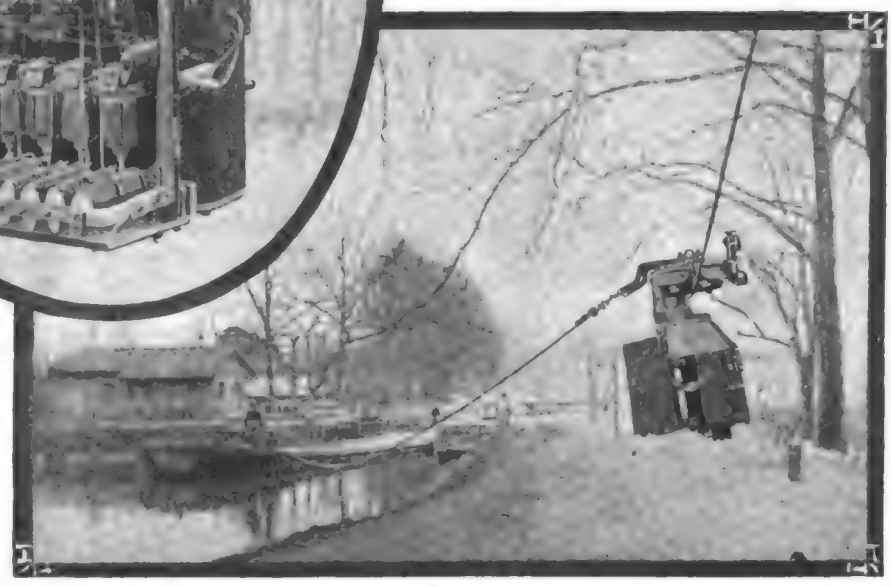
Electric "Mule" Hauls French Canal Boats





This Electric "Mule" Serves to Haul French Canal Boats and It Would Seem to Merit the Study of American Engineers. As Will Be Seen an Electric Motor Is Geared to Friction Wheels Which Cause the "Mule" to Progress Along the Cable, Current Being Supplied to the Motor from a Trolley Wire by Means of a Shoe-Sliding Along It.

WE illustrate a system of traction for canal boats which has been subjected to a full sized scale working trial on the Saint-Maurice Canal, near Paris. The illustrations explain themselves to a great extent—a cable is carried parallel to the canal and on it a species of aerial locomotive or tractor travels by electric power. The weight of the tractor is only about 1,300 pounds. It contains a ten-horsepower series wound motor operating at 500 volts. It is carried by two vertical grooved wheels running on the cable, while the traction is given by two pairs of horizontally opposed wheels which grip the cable between them and are actuated by the electric motor. By a system of levers the traction effect can be multiplied to any desired extent, so that there will be no slipping. Universal joints are used to improve the flexibility of the mechanism so that it can adapt itself to all the inevitable irregularities of a suspended cable. The man in charge of the canal boat regulates the action of the tractor. By means of the traction cable he is able to release the traction wheels from their pressure upon the cable, and the motor is started and stopt and the traction rollers are controlled from the boat entirely by the towing line.

In the general view is shown the system of supporting the heavy steel cable which carries the weight of the traction engine. It will be observed that the shape of the frame-work or chassis of the tractor is such as to enable it to pass the points of support of the cable without hitting the poles. Its light weight enables a comparatively small cable and reasonably light poles to be used for carrying it. The power is taken from an overhead power wire whose supports can also be seen in the picture. The boat is just entering a lock and the photograph certainly presents an interesting view of French canal practise. The detailed view of the tractor, with its casing removed, shows the resistance coils and general electric controlling apparatus, all of which at first sight at least, seem somewhat complicated.

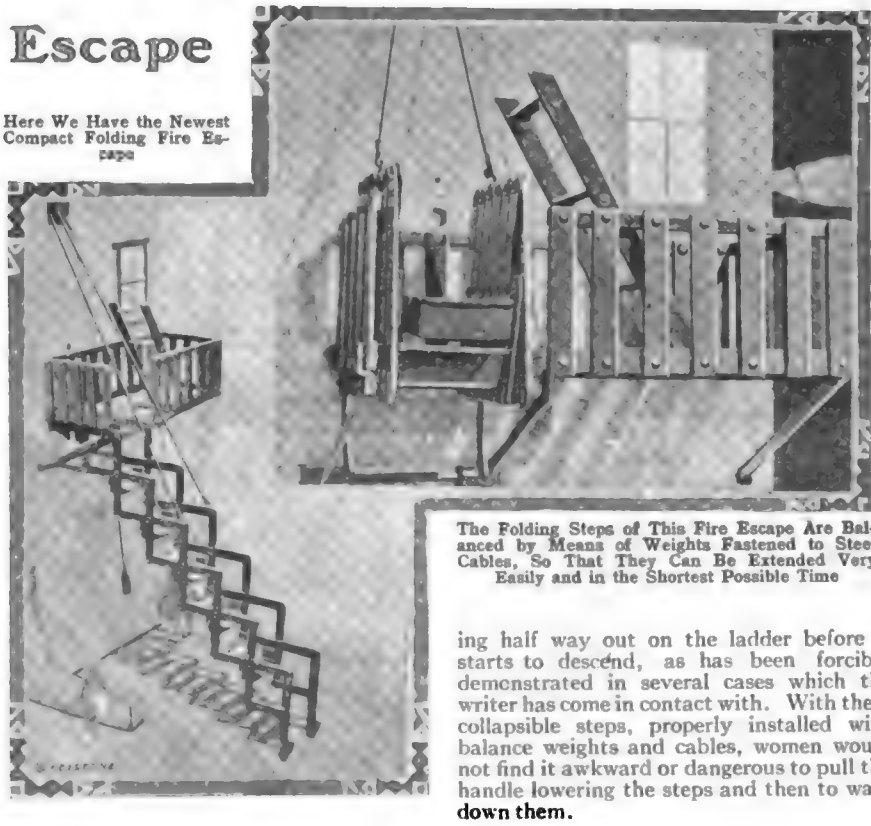
A Folding Fire Escape

The two accompanying photographs illustrate one of the latest and best devices yet brought out for the protection of humankind when a fire breaks out in residences or hotels, etc. This very ingenious fire escape when not in use folds compactly against the side of a building, as shown in one of the photographs herewith. The device consists of a lazy-tong step-extension, which can be extended to the ground as shown in the second photo.

This lazy-tong extension can be easily controlled from the balcony, when the collapsible steps are folded into two tiers, one above the other. A child can easily lower this device and descend in safety to the ground. The steps are so arranged that it is said there is not the slightest danger to a person descending them. Not a jar is felt in this operation due to the well adjusted construction.

The folding steps are balanced by means of weights fastened to steel cables, which pass over pulleys mounted in the wall of the building, as becomes apparent by looking closely at the accompanying photos. This arrangement of the fire escape steps would seem to be a decided improvement over the solid steel ladder or stair used on the average fire escape today, as these do not always operate so easily as intended, and where women happen to be the first ones to push these ladders down in the event of a conflagration, they do not like the idea of walking half way out on the ladder before it starts to descend, as has been forcibly demonstrated in several cases which the writer has come in contact with. With these collapsible steps, properly installed with balance weights and cables, women would not find it awkward or dangerous to pull the handle lowering the steps and then to walk down them.

Here We Have the Newest Compact Folding Fire Escape



The Folding Steps of This Fire Escape Are Balanced by Means of Weights Fastened to Steel Cables, So That They Can Be Extended Very Easily and in the Shortest Possible Time

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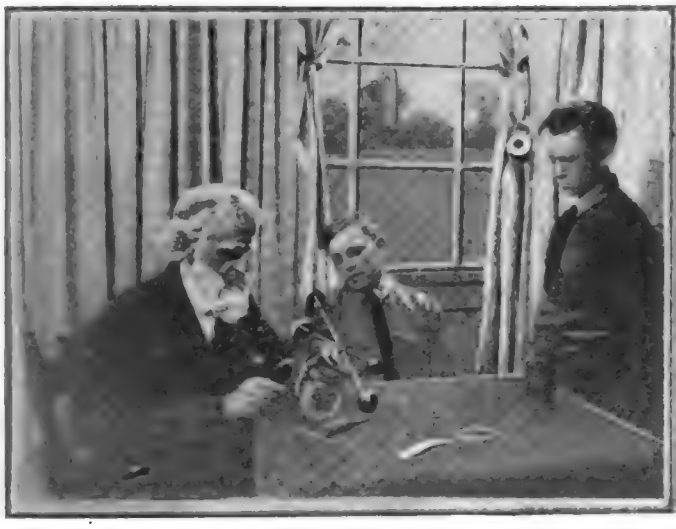
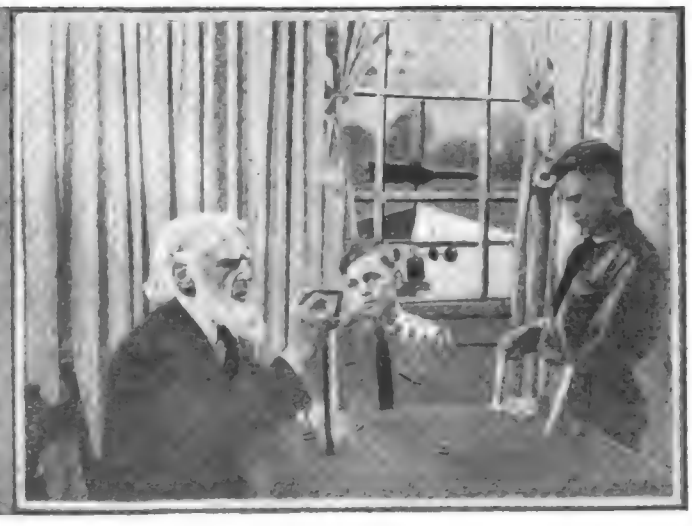
A Home Weather Bureau



One of the Best Experimental Outfits for Boys, Especially for Boy Scout Troops, Is the New Weather Forecasting Set Shown Above. The Outfit Includes an Aneroid Barometer and a Maximum and Minimum Thermometer as Well as Wind Gage, Which the Instructor Is Shown Demonstrating.



The Experimental Weather Outfit Also Includes a Very Well Made Rain Measuring Gage, Here Being Demonstrated by the Instructor, While the Weather Vane and Anemometer Is Seen Outside the Window. The Boy Scout at the Right Holds the Wet and Dry Bulb Humidity Thermometers.

HOW many of us have often wished and longed for an outfit, wherewith we could predict weather, without the necessity of relying upon newspapers eight or ten hours old, to tell us what the afternoon will bring forth. Very often the report is found erroneous, while at the same time it may have caused us to abandon a much desired trip. A leading toy manufacturer in this country has now stept forward with a small weather bureau outfit, which can be placed in the hands of any enthusiastic experimenter or anyone interested in the science of weather prophesying. This outfit comes complete with a very interesting instruction book. In our photographs we show some of this apparatus set up. Thus there is a weather-vane or a wind-vane, to express the term correctly, indicating the direction of the wind. An anemometer is included which enables us to determine the velocity of the wind. This anemometer on rotating operates a series of gears, one of which makes contact every revolution with a spring, closing an electric circuit. Wires are led from the anemometer thru two batteries, to a small incandescent light, so that for every revolution of the brush-holding gear, the light will flash. The number of flashes of light in 15 seconds will give the velocity of the wind in miles per hour.

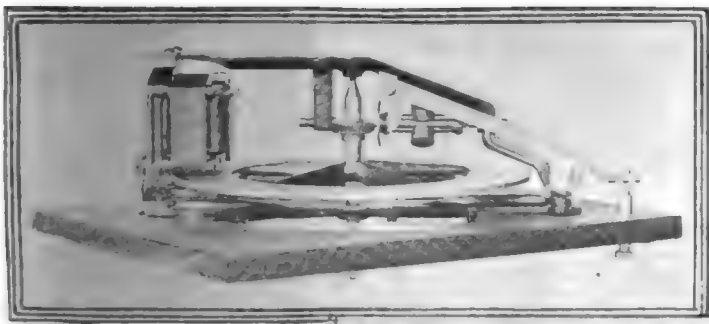
Then there is a sunshine recorder consisting of a metal case, cylindrical in form, with metal caps turned upon the ends. On each side of the case are small holes, thru which the sun casts its rays and records its movements, the duration and intensity of its light upon a small piece of blueprint paper inside the cylinder. When the paper is soaked in water, so as to be developed, a permanent record is obtained. Another very wonderful piece of apparatus included is an aneroid barometer. Thus if the barometer has been standing at 30.9 and suddenly drops to 29.5 or below, it would generally indicate rain. A maximum and minimum thermometer is included in the outfit, which are to be set by the aid of a magnet and wet and dry thermometers are also to be found together with a table of relative humidities. Last but not least, a rain gage, beautifully nickeled, is included and the price of the outfit is so reasonable that no experimenter, and in fact, no one who is at all interested in the weather (and we all are), should be without it.—*Photos courtesy A. C. Gilbert Company, by our staff photographer.*

Simple Induction Motor for Phonograph

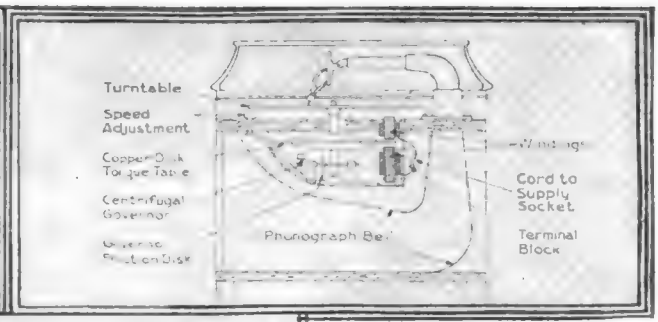
The elimination of noise has been the stumbling block for most attempts at electric drive for phonograph motors, this being due to the fact that the motor is mounted directly above the bell or sounding apparatus of the phonograph, and any tendency to vibrate is immediately amplified so as to interfere with the reproduction of the record.

consists of a rotating element fastened to the shaft of the turn-table and running between two field coils. The rotor is formed of a ring of copper of about six inches inside diameter and about one and a half inches wide supported from the main shaft by a cast aluminum spider.

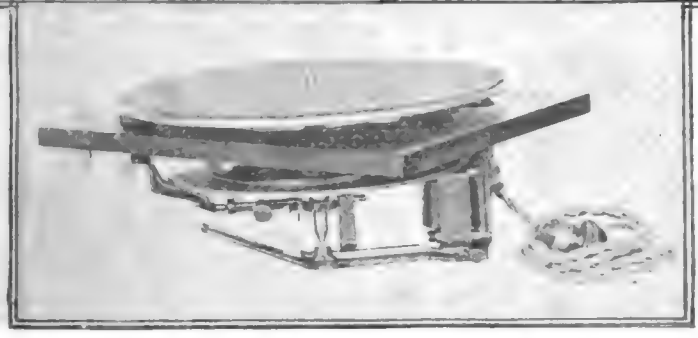
The rotor revolves thru a shifting magnetic field produced by field coils wound on laminated magnetic circuits. Thus, since the revolving element is fastened directly to the main shaft, all necessity for high speed gearing, belting, or friction drive is entirely eliminated. This main shaft is supported below on an adjustable, hardened steel ball step-bearing in the lower bracket.



The Latest and the Simplest Alternating Current Phonograph Motor. The Rotor Is a Ring of Copper Pulled Around by the A. C. Electro-Magnet



The Arrangement of the New Alternating Current Phonograph Motor Is Here Shown, Ready to Operate a Pathé Machine. The Motor Exerts Maximum Pull at Starting



Chester I. Hall, an electrical engineer has developed a new electric motor to be used on phonographs.

It is a small induction motor somewhat similar to those used as the motive power of induction watt-hour meters, and

It was found quite difficult to eliminate the noise caused by the magnetic hum, due to the sixty cycle circuit, but this was accomplished by a proper design of the supporting brackets and spider, as well as by the elimination of vibration in the motor board itself.

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The "Aerohydrotor"

By EDWIN F. LINDER

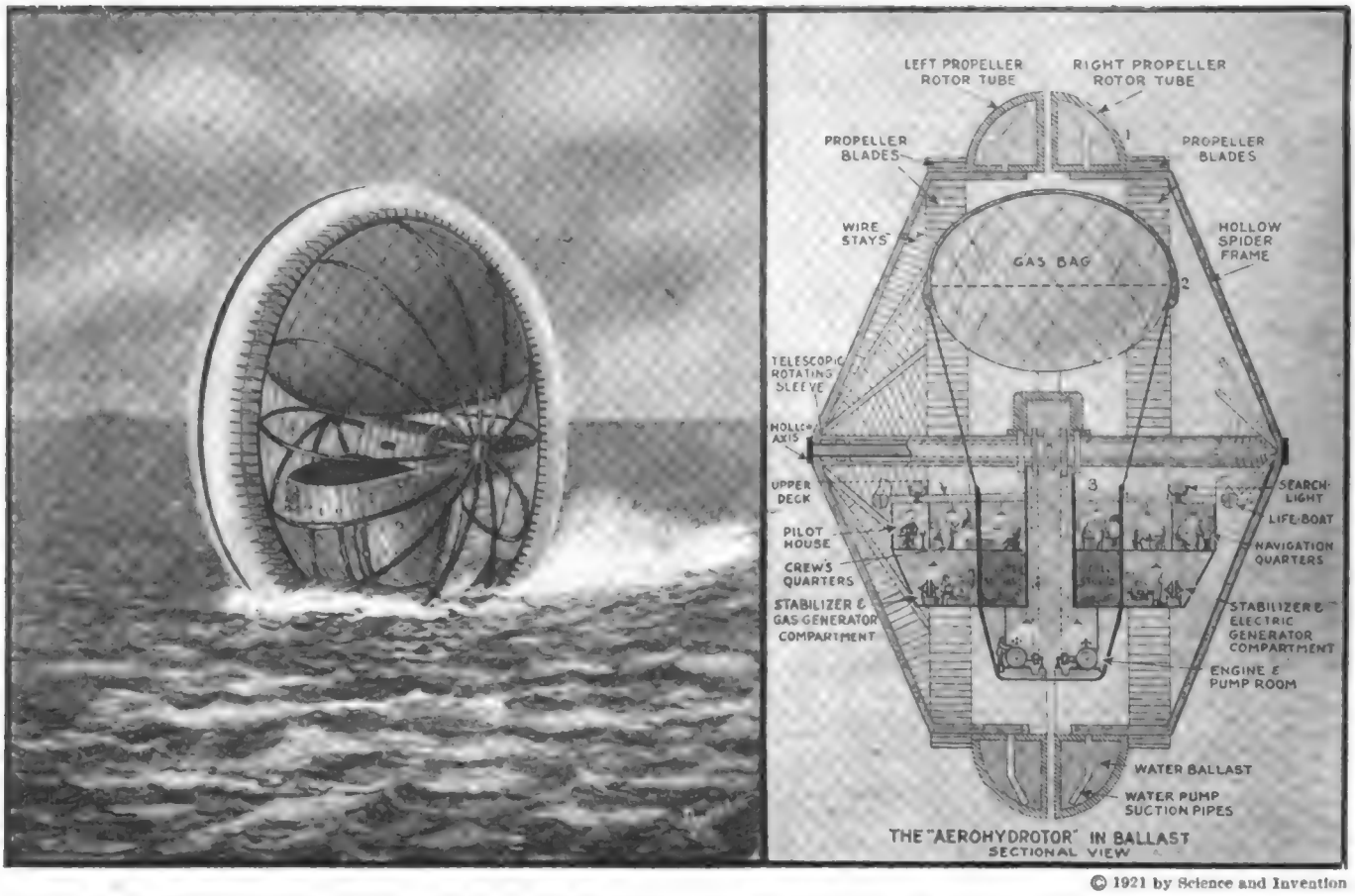
TALK about speed! Is 200 miles per hour a fast clip? Well, that figures 3 1-3 miles per minute or 290 feet per second. Now, that may seem a great distance to cover in a short space of time, yet if exprest in terms of rotation it will appear to the trained mechanical mind to be rather ordinary.

The Aerohydrotor is designed to travel at the rate of 200 miles an hour under normal conditions. The diameter of the propeller-rotors being about of smaller proportions produced for purposes of super-rapid ocean transit.

In describing the construction of this "Speed King of the Seas" it may be of interest to state that the craft consists chiefly of three units. "No. 1"—the propeller-rotor-tube, which takes the place of the usual hull. "No. 2"—the gas-bag. "No. 3"—the quarters, pilot and machine compartments. When in operation Units "No. 2" and "No. 3" remain in a fixt position, while "No. 1" revolves.

It can be easily understood that the steering is accomplished by speeding up or slowing down one or the other side of the spider-frame driven on the axis, upon which are mounted telescopic sleeves carrying the driving gears. The spider frame arms are hollow; thru these ballast water is expelled after the Aerohydrotor starts on its voyage.

On approaching its destination ballast water is again pumped into the tube. In this manner a greater degree of stability is maintained.



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The "Aero-hyd-rotor" is the Latest Idea in Ocean-Going Craft and is Designed to Travel at a Speed of 200 Miles Per Hour or More, so That It Could Cross the Atlantic in 12 to 16 Hours. The Gigantic Wheel with Its Propelling Blades Measures 93 Feet in Diameter. The Craft is Kept Upright by Gyroscopic Action and Also by the Huge Gas Bag at the Top, Which is Filled With Helium—the New Non-Inflammable Balloon Inflating Medium. Gas or Gasoline Engines Drive the Craft

93 feet. Let us assume, for the purpose of illustration, that friction and air resistances are not to be considered and that the diameter of the propeller-rotors is 93 feet. With each revolution thereof a distance of 290 feet can be attained.

As the Aerohydrotor is so constructed that it makes at an average one revolution per second—only sixty turns each minute—it surely can not be said to be breaking the record for rotation. This is really a very old fashioned rate, compared to high speed electro-motors running 1,000 revolutions per minute, or even higher. So with the one turn the Aerohydrotor traverses over 290 feet each second, or in sixty turns — 17,400 feet (3.3 miles) per minute. Then in making 3,600 revolutions per hour — a very low rate indeed—it leaves in its wake just 1,044,000 feet or 200 miles.

It is quite possible that by tuning up the Aerohydrotor a much higher rate of speed will eventually be obtained, or the same distance covered with a craft

So far as possible all parts are made of dur-aluminum, and wire stayed. This lends both strength and the necessary feature of light weight to the structure.

The motive power is furnished by the installation of gas engines, located in the lower compartment, which is shown suspended from the passenger quarters. Stabilizers assist in keeping the craft in an upright position while in motion, the gas bag, at the same time, performing this service besides lifting the craft so that it keeps up well on the surface of the water. Light and heat are derived from an electric generator unit. Water pumps, a gas generator to replenish the supply are included in the equipment.

It is difficult to explain, without going into great detail, the peculiar construction of the rotor-tube and propeller-blade ring. These are arranged so that each can be driven independently of the other, the tube being split, half rotating with each set of propeller rings.

At this time it is not intended that the Aerohydrotor should be used for other than passenger and mail service in a limited way, where super-speed is of the greatest importance. While its advantages possibly do not contribute to the improvement in a large degree in the commercial field, except as a medium of rapid exchange of mail, the use to which such a speedy craft can be put as a weapon of destruction on the high seas in naval warfare is worthy of consideration. A fleet of these, acting as scouts to locate enemy squadrons, could patrol so great an area distant from defensive lines, that long before the approaching squadrons need be met in combat, all necessary arrangements for the attack could be made.

Let us hope, however, that the Aerohydrotor will only be used for the peaceful purposes of super-transit on the great highways of the seas.

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Mechanics in Animal Life

By WILLIAM BUTTERFIELD

Above: Ox-Fly Tools (Fleshy Covering Removed) Compared to Abcess Knife and Lancet

Above: Hypodermic Syringe Compared with the Fangs in the Head of an Adder.

Photo Below Illustrates Paddles of a Whirligig, Compared with a Duck's Feet.

Above: Saws of the Saw-fly, and Below, Spiral Breathing Tubes of Insect.

Left: Spider's foot with Combs —Head and Bill of Toucan Showing Cutters (Scisors).

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THE human body is often referred to as a steam engine, the stomach as a furnace, the lungs as a pair of bellows, the eye as a photographic camera, the heart as a pump, with other similes of this kind. Do such mechanical resemblances exist? They most assuredly do. And furthermore, the machinery which man makes not only resembles parts of his own body at times, but every invention of his in the tool line seems to be a duplicate of a portion of the structure of some animal or plant.

Nor are these resemblances in form only, for we find that they are actual working replicas—the physical member being in all cases more perfect in its operation and workmanship than is the artificial duplication. This sort of duplication is common everywhere in nature and art, the remarkable, if not disconcerting part of it to most men is, that now after all the ages of human development he finds his inventive genius to be only a kind of animal instinct, and that all of his multitudinous labors and achievements are only exemplifications of the same kind of energy that creates an ant hill or a beaver dam.

One cannot carefully review the facts revealed to us everywhere without recognizing the existence of this common team-work. Man, for instance, after mental effort, experiment and research, creates an abscess knife and lancet. Both represent the most perfect, smooth cutting instruments that he is capable of producing. Experiment has determined their proportions and shapes, but nothing he can do, prevents their getting dull after a cut or two or becoming rusty or dirty. Now entirely unknown to the knife-maker, Dame Nature is turning out millions of tools of this identical nature. They are so small that the human maker cannot see them without the aid of a microscope, but they are so much like his knives, that the resemblance is not only startling—it is positively uncanny.

What are these knives and lancets? What are their use? They form part of the blood-sucking outfit of the ox-fly, which, in addition to the two pairs of cutting tools, is fitted with a central sucking tube and two hair-covered sponge lobes for cleaning purposes (see drawing upper left view). It is discouraging to a knife-maker to see this fly use these cutting tools; they never get dull, clogged or rusty. The insect jabs them thru the tough hide of an ox, cow, or horse, over and over again—a new jab with every swing of the dislodging tail or stamp of the vicious hoof of the troubled beast.

Every variety of saw-fly has attached to the abdomen of its female a familiar style of keyhole saw, that is formed of two flexible blades with T-shaped backs which engage suitable grooves in the fixt parts of this divided structure. The saws move back and forth in these grooves held in line by their backs clamped in the grooves. The saw teeth are of different sizes, all are reinforced at their sides. The whole apparatus is so flexible that it forms either a pair of flattened saws or a round tube. With this complicated tool, consisting of moving saws, frames, and motive machinery in the form of muscles, etc., the insect cuts incisions like key-holes in the hardest vegetable material, and with such ease and dispatch, that the tool is more often called an auger than a saw (see drawing at top center).

The hypodermic syringe is a highly specialized tool representing in its purpose, if not in its make, a high degree of human intelligence. It consists of a hollow needle, barrel-reservoir, and ejecting arrangement, and is used so that narcotizing or other fluid can be made to enter the tissues or blood of the person operated upon. Now this idea is over a hundred thousand years old; the serpent has two fangs that have all of the qualifications of a hypodermic syringe, with a few additional ones—the reservoirs are self-filling, there are self-ejectors and the needles (fangs) have a way of keeping open even if not clean externally. Other animals are provided with this tool (stinging insects, spiders, etc.) and a whole volume would be written on the sagacity, or knowledge with which it is used for different purposes by animals.

(*Continued on page 272*)

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Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(Author's Note. It is certain that at no distant day, men will have discovered means of magnifying small objects to an extent at present undreamed of. As light and sound are both vibrations, it would seem as though the audion, which now magnifies sounds to any magnitude desired, should also, with certain modifications, be able to magnify the light vibrations. A series of audions should thus serve as a microscope which will bring into our range of vision objects now invisible in our most powerful instruments. That day the secret of the atom will be solved!)

NO. 2—THE SECRET OF THE ATOM

"WELL, Doctor Hackensaw, here I am again!"

The speaker was Mr. Silas Rockett, reporter for The New York Daily Growl.

"Glad to see you, Mr. Rockett. What can I do for you today?"

"Well, our readers were so pleased with the first interview I had with you, that our chief has sent me to see if you have any new inventions to make public."

"You come just at the right time, Mr. Rockett, for I have just perfected an instrument which I regard as one of the greatest discoveries of our time. This instrument will open up new worlds for man to conquer and will lay bare many of the secrets of nature. And yet it is so simple, and my share in the invention is so small that I am afraid I shall never be given any credit for it."

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". . . And Now the Image, Instead of a Mass of Wriggling Animalcules, Showed Only One Fierce-Looking Creature, Unlike Anything the Reporter Had Ever Seen. . . ."

"And what is your invention, may I ask?"

"My invention," said the doctor, "is what I call a *super-microscope*."

"Is that all?" exclaimed Silas Rockett in a disappointed tone. "Just an improved microscope?"

"Yes," returned the doctor, smiling, "that is all! My invention is nothing but an improved microscope, and yet it is destined to revolutionize every branch of science and give an impetus to our arts and manufactures that will throw all past achievements in the shade. But let me first show you my instrument."

Doctor Hackensaw led the way into an adjoining room which was bare of furniture and which seemed to contain nothing but four microscopes, a camera, and some moving picture machines.

"These," explained the doctor, "are my first experiments before I struck the right path. What I wanted to find was a microscope capable of enlarging a minute object to any size desired, an instrument that would be as far superior to our best microscopes of today as these are to the human eye."

"Indeed?"

"Yes, and the problem seemed to me a very simple one. If one microscope can magnify an object a hundred diameters, it seemed to me that by catching the magnified image and viewing it through another microscope of like power, the image would then be ten thousand times the diameter of the original object, and by continuing this process I could secure any degree of magnification desired."

"And did you succeed?"

"Within certain limits, yes. You will readily understand my method from the apparatus here. I first make a microphotograph of some microscopic object. This first photograph made on a moving picture film is about one hundred times the diameter of the object photographed. By throwing this image on a screen by means of a moving picture lantern I enlarge it again a hundred times. You will note, however, that my screen instead of hanging like a curtain, as in a movie theatre, lies flat on the floor like a carpet. In fact the screen is of celluloid and forms the surface of the floor. The image, caught on the floor, is thus ten thousand times the size of the original object. Upon any desired point of this image I place a second microscope through which I make a new micro-photograph of the object one hundred times the size of the magnified image. This second film I project again upon the floor in a new place, thus magnifying the image again a hundred times. The image now is ten thousand times ten thousand times the diameter of the original, or in other words I have magnified the object one hundred million times and yet have used only two microscopes and two screens. By using two more of each I can obtain a magnification of ten quadrillion diameters!"

"Whew!" ejaculated the reporter. "Surely that ought to satisfy you. If you can do that with only four microscopes and four moving picture machines, you ought to be satisfied. I don't wonder you call it a super-microscope."

"Yes," returned Doctor Hackensaw, "but the trouble is these methods are so clumsy that the picture loses in distinctness at each enlargement. The first trouble is the illumination. I am able to throw an intense illumination upon the object to be enlarged, by first filtering out the heat and chemical rays that might injure my specimen. Then, too, I use an intense light in my movie projector, and in lighting the screens for subsequent photographs."

(*Continued on page* 266)

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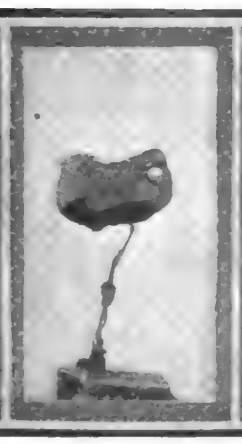
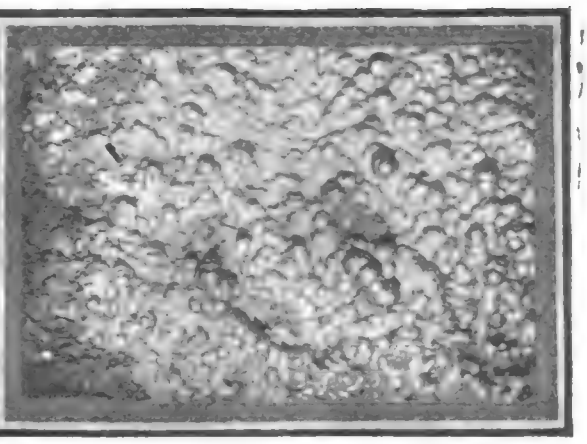
Liquid Carbon

By Dr. ALFRED GRADENWITZ

The View Above Shows Melted Portions of Carbon at Surface of Electrode.



A Bright Drop or Globule of Melted Carbon.



Demonstrating Vividly How Carbon Was Successfully Melted by Electricity—Solidified Drops Greatly Magnified.

TO the man of science, there can no longer be any doubt as to the possibility of obtaining all chemical elements in any one of the three states of aggregation—*solid, liquid and gaseous!* Still there was so far one element which in some way occupied an exceptional position—indeed, one of the most important and most wide-spread elements, viz. *carbon,* which had never with absolute certainty been shown to be obtained in a liquid condition, and the opinion was therefore widely prevalent that carbon could not at all be liquefied. In the electric arc, it of course exists in a gaseous condition, but it was frequently thought that solid carbon in this case did not pass thru any intermediate. The problem was all the more interesting, as the liquefying of carbon, according to Moissan's early experiments, seemed to be connected with the artificial production of diamonds.

Tho many attempts had been made at the high temperature of the electric furnaces to convert carbon into the liquid state, no absolute evidence of positive results was so far available. Prof. Lummer, some years ago, investigated the problem in a very thoro-going manner, but failed to obtain really con-

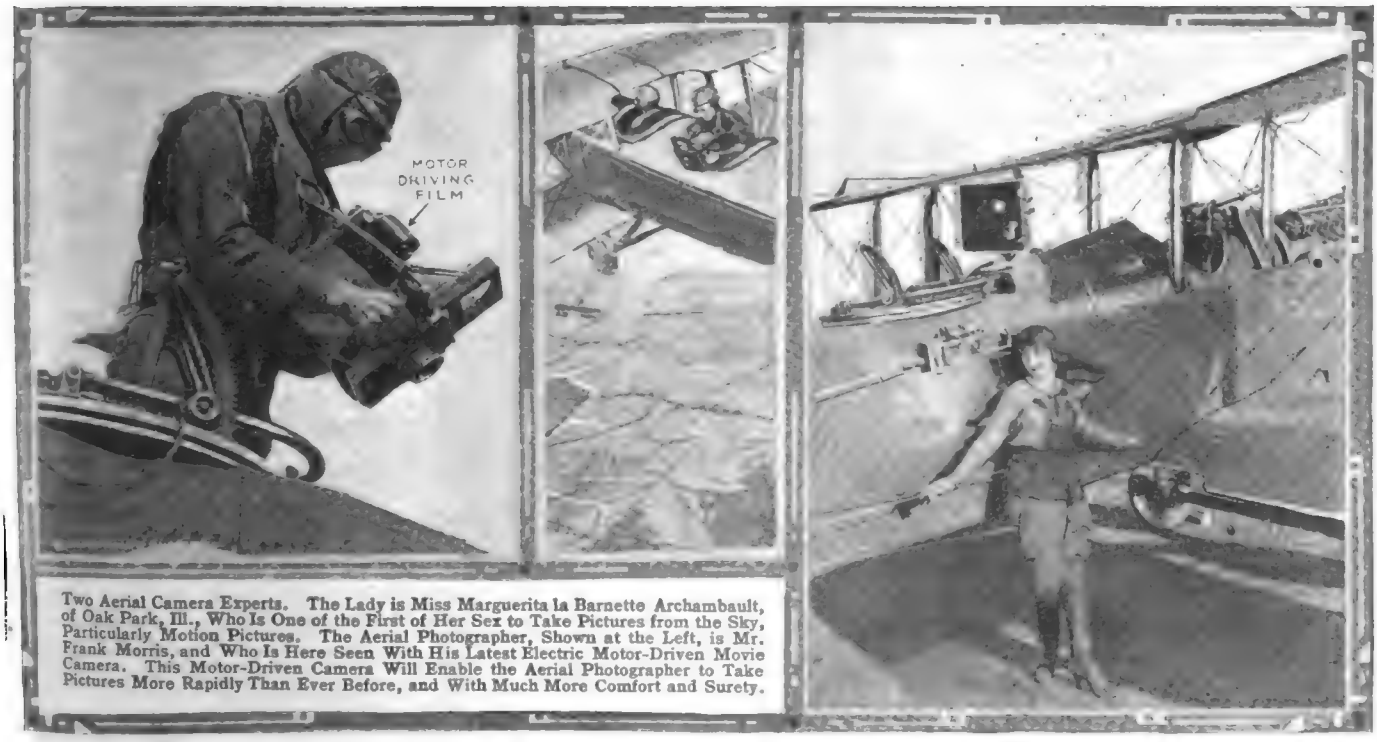
(*Continued on page* 256)

Photo-Mapping from the Air

THE school geography of to-morrow will differ undoubtedly in many respects from those; which have been in use in our schools during the past twenty years, in that they will be provided with a wealth of airplane views of famous spots, such as mountain ranges, lakes, and inland seas, so that when the student finishes studying one of these ultra-modern geographies he will have almost as clear a knowledge and mental image of these famous places, as if he had actually traveled over the ground himself.

We illustrate an invention of Mr. Frank Morris who has added to the camera an appliance which causes a miniature electric motor to do the cranking work, usually imposed upon the photographer. The motor driven by an eight volt, 60 ampere-hour battery, does the work otherwise performed by hand by the movie operator, so that the film is "ground out" by electricity. It applies especially to aerial photography, giving a fixt speed of the motor and abolishing all unevenness of feed.

We also give the portrait of Miss Marguerita la Barnette Archambault, who is one of the first of her sex to take "movie" pictures from the sky. She has even crost the frontier into Mexico and has made most successful pictures. In one case she took pictures at an elevation of 2000 feet while the airplane was traveling at 100 miles per hour, and stood up in the plane at the risk of her life to accomplish her mission.



Two Aerial Camera Experts. The Lady is Miss Marguerita la Barnette Archambault, of Oak Park, Ill., Who Is One of the First of Her Sex to Take Pictures from the Sky, Particularly Motion Pictures. The Aerial Photographer, Shown at the Left, is Mr. Frank Morris, and Who Is Here Seen With His Latest Electric Motor-Driven Movie Camera. This Motor-Driven Camera Will Enable the Aerial Photographer to Take Pictures More Rapidly Than Ever Before, and With Much More Comfort and Surety.

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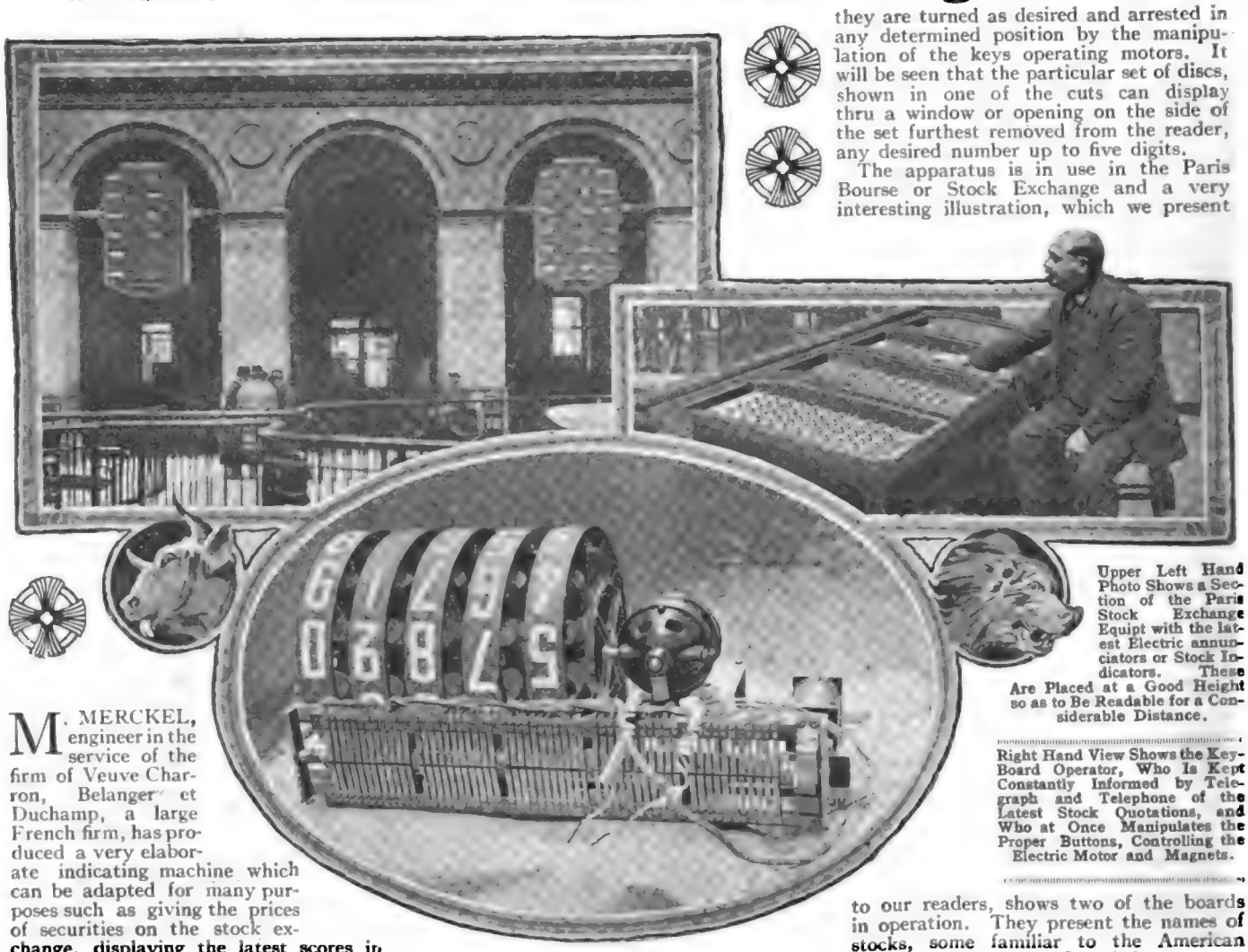
French Electric Score Indicating Board



Upper Left Hand Photo Shows a Section of the Paris Stock Exchange Equipt with the latest Electric annunciators or Stock Indicators. These Are Placed at a Good Height so as to Be Readable for a Considerable Distance.

Right Hand View Shows the Key-Board Operator, Who Is Kept Constantly Informed by Telegraph and Telephone of the Latest Stock Quotations, and Who at Once Manipulates the Proper Buttons, Controlling the Electric Motor and Magnets.

M. MERCKEL, engineer in the service of the firm of Veuve Charron, Belanger et Duchamp, a large French firm, has produced a very elaborate indicating machine which can be adapted for many purposes such as giving the prices of securities on the stock exchange, displaying the latest scores in a ball game, or the figures in a horse race, and we illustrate some of the features of this machine.

The first illustration shows the operator seated at a desk with a great number of keys in front of him, to a certain extent suggestive of a telephone system. By operating these keys, he causes discs, back of the display board and carrying numbers, to be rotated by electricity and to be stopt at any desired position so as to give different readings. Without going into details of the exact electrical construction it is sufficient to mention that they are turned as desired and arrested in any determined position by the manipulation of the keys operating motors. It will be seen that the particular set of discs, shown in one of the cuts can display thru a window or opening on the side of the set furthest removed from the reader, any desired number up to five digits.

The apparatus is in use in the Paris Bourse or Stock Exchange and a very interesting illustration, which we present to our readers, shows two of the boards in operation. They present the names of stocks, some familiar to the American broker, and by the Merckel apparatus the prices can be instantly displayed to give quotations of the various securities. The illustration is of special interest, showing the interior of the Paris Bourse, which is one of the leading institutions of its kind in the world.

Electric Banjo and Xylophone

An Enterprising American Minstrel Has Worked Out and Built for Himself, an Electrically Played Xylophone. As the Strings on the Banjo Are Played the Circuits Are Closed Automatically, Which Causes the Electric Bell Hammers to Strike the Glass Discs.

OUR readers are familiar with with the peripatetic musicians, who perform on a number of instruments simultaneously, using hands, mouth and feet for the different types of instruments. In the electric installation we illustrate, is shown the last thing in this line of multiple performance, where the musical expert calls upon the electrical engineer to help him out in his efforts to do two or more men's work in one.

Two instruments only are played in the present case. The hand working on the fret board of the banjo, incidentally plays a second instrument. The twang of the banjo is softened down by the liquid notes of the tuned glass disks constituting the so-called xylophone, and the effect of the two instruments is certainly to be admired.

Now, as our Mr. Kirk strums his banjo gaily in the spotlight the glass discs of the "xylophone" ring out in perfect unison with the notes and chords struck on the banjo. As the photograph shows, the wiring is carried out very neatly and efficiently. The keyboard for playing the various tuned glass discs in the "xylophone" shown at the right is placed in the hollowed out neck of the banjo. Above each fret on the neck of the banjo, a peg or button projects, and this is so arranged that when each respective button is deprest by pressing on the string at the same time, the circuit to the proper "xylophone" disc is energized with battery current. The glass discs are played by means of electric bells with the gong and its support removed.

Vibrating electric bell movements are very useful for playing this and other musical instruments the end of the hammer rod being fitted with a wood or other ball, the material used depending upon which instrument or device is to be played.

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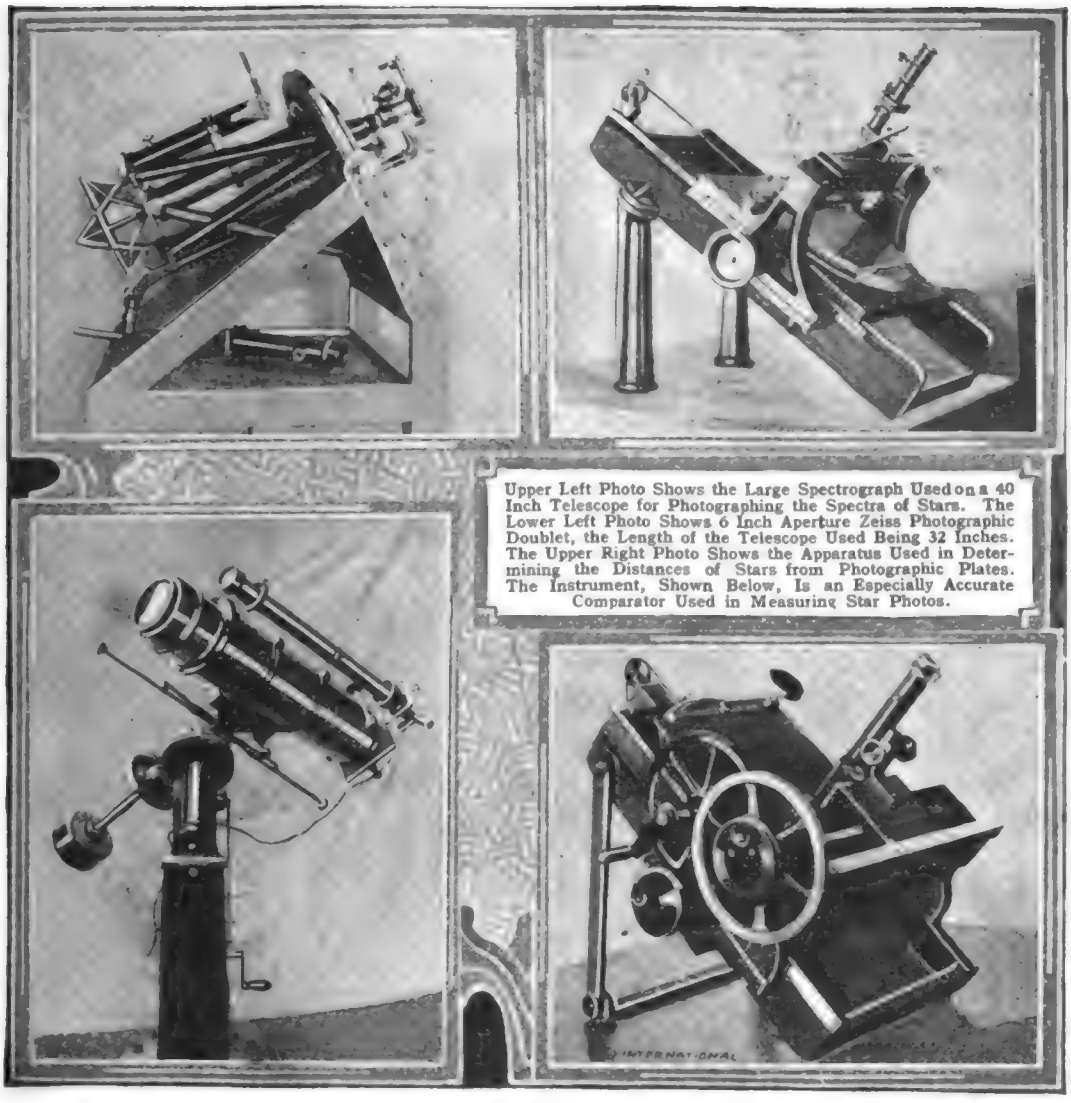
Instruments That Measure the Stars

THE instruments here illustrated are used in measuring the velocity as well as the distance of stars. The photos were taken by Yerkes Observatory of the University of Chicago, the observatory being located at Williams Bay, Wisconsin. The first instrument illustrated is a large spectrograph which is attached to the 40-inch telescope for photographing the spectra of stars. In the picture the instrument is resting on its carriage before being attached to the telescope. The light enters at the right through a narrow slit and travels downward toward the left, passing through a lens. Then the light passes through the three triangular prisms of large size, seen at the left, which spread the light out into a long ribbon of color, of red, orange, yellow, green, blue, indigo and violet, the last named rays being the most bent or refracted. These rays then enter the steel camera tube, 4 inches in diameter, at the top of the instrument, by which they are photographed. In use, the prisms and the cameras are covered by two separate casings of aluminum, to prevent changes of temperature during exposure. This is aided by coils of wire, which are electrically heated as the temperature falls. At the right-hand upper part of the instrument is seen a small drum containing points of different chemical elements. An electric spark is caused to pass between these points and the light is reflected down into the spectrograph, so that alongside of the spectrum of a star we obtain the well known spectrum of some chemical element which has been studied before. With this instrument it is possible to measure the speed of the stars in miles per second, as they are approaching or receding from the earth. Some stars move with velocities of 100 miles per second, or even faster. The average yellow star, like our sun, moves at about 12 miles per second in the line of sight.



Upper Left Photo Shows the Large Spectrograph Used on a 40 Inch Telescope for Photographing the Spectra of Stars. The Lower Left Photo Shows 6 Inch Aperture Zeiss Photographic Doublet, the Length of the Telescope Used Being 32 Inches. The Upper Right Photo Shows the Apparatus Used in Determining the Distances of Stars from Photographic Plates. The Instrument, Shown Below, Is an Especially Accurate Comparator Used in Measuring Star Photos.

ZEISS PHOTOGRAPHIC DOUBLET

The objective of this instrument, of about six inches aperture, is made of a

(*Continued on page* 272)

This Piano Has Two Keyboards

In presenting many musical acts two or more pianos have been used from time to time, especially in giving ducts and quartette acts. However, the first piano to be provided with two keyboards, so that a duet by two different players can be presented simultaneously, is shown in the accompanying photograph. This is known as a double concert piano. The present photograph shows the well-known pianists Leonore Erdman and Werner Eichorn, playing fourhanded on this unusual invention.

Here We See Two Well-Known Pianists Performing on a Four-Handed Piano. Exceptional Harmony and Other Merits Are Claimed for This Arrangement of a Double Piano.

Each keyboard operates a separate set of strings, as it would of course be impossible to have two different keys striking the same string at the same time. The cover of the piano can be left in place or also removed to give the desired volume of sound. Possibly tomorrow will see a six or eight-handed piano with three or four people playing on the same instrument at the same time. This would make a very spectacular showing and possess superior qualities.

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Automatic Burglar Alarm

The Accompanying Illustration Shows a Recently Patented Burglar Alarm, Which Comprises a Phonograph of the Wax Cylinder Type, Connected with the City Telephone System. Whenever the Window to Which the Apparatus Is Electrically Connected Is Tampered with, the Phonograph Mechanism Raises the Switch Hook, Connects the Instrument with "Central," and the Record Starts to Yell.

At the present day, there is a contest between the law-abiding community and the burglar, with the latter apparently winning out at times.

Our illustration shows a burglar alarm, operated by a phonograph and telephone system. When a door or window to which the apparatus is electrically connected is opened or tampered with, the phonograph is started into operation. The phonograph record contains any desired signal or message. Opposite the horn of the phonograph, is a telephone receiver and the message is transmitted thereby to the nearest police station.

The phonograph record gives the number of the building so that the police can at once go to the right place without any time being lost in determining where the robbery is being perpetrated.

A similar idea to this one was publisht about a year ago in the columns of this journal, describing the application of a phonograph containing a record on which the number and street were recorded and which was arranged so that in case of fire, the phonograph was released, the telephone receiver hook lifted so as to connect with central or police headquarters—and in a few seconds the record would give the exact location of the fire, even to the room.

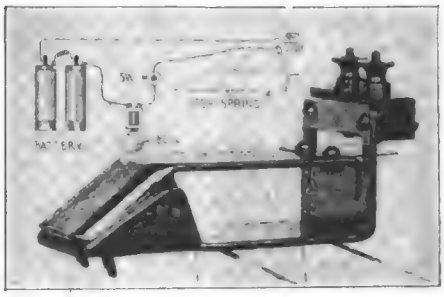
Novel Electric Burglar Alarm

In these stirring times we are not only suffering from underproduction but we are being over-burglarized as well. The French who are having their share of it, have recently brought out a little instrument designed to protect hotel transients, travelers of all descriptions, as well as those permanently situated.

As may be seen from the illustration, the device is furnisht with small metal notches so that it may be readily adjusted in a room near any part of a door. After this an electric alarm bell, as well as a flashlight battery or else regular dry cells are connected in the circuit by means of the two binding posts shown.

Owing to the fact that the instrument and the wires are competely within the inside part of the room, it is inaccessible to an outsider having the cutting of the wires in mind. The device being firmly gripped by the flooring, as soon as the door is opened to even a very slight extent, the jaws shown are instantly closed, thereby making contact and ringing the bell.

The portable and readily adjustable nature of the instrument has made it a great favorite among the Europeans, particularly among the traveling class.—*Pierre H. Boucheron.*

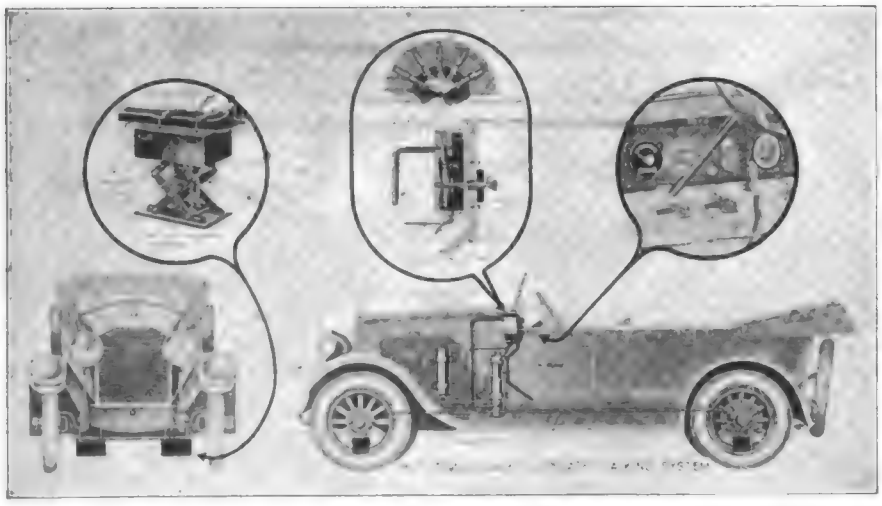


When the Burglar Opens the Door, the Electric Contacts of This French Alarm Device Are Closed and the Electric Gong Sounds.

Oil Jacking System for Autos

Ordinary lubricating oil is carried in a tank under the hood of the car in this new oiling and jacking system, and drawn therefrom by a single cylinder pump, the pump being operated by gears off of the magneto shaft. The oil is forced into the reservoir attached in front of the dash (under the hood) under pressure. From the reservoir ordinary brass or copper tubing runs to the various grease-cups on the car. The grease-cups are self-closing, of the ball socket type.

When it is desired to lubricate any part of the car, the indicator knob on the dash is turned to the number corresponding with the particular cup that is to be filled, or, in the event that it is desired to oil all parts of the car, the indicator knob may be turned to a certain point, and in two minutes every cup will be filled with oil *under pressure.*



Something Really New in the Automobile World—An Oil Jacking and Lubricating System Whereby Any Part of a Car Can Be Lubricated, or When Desired the Entire Car Can Be Raised on the Four Oil Jacks Shown in Black Under the Front and Rear Axles.

The operation of the jacking system is practically the same as the oiling system insofar as the reservoir, pump, valves, cams and pipe-lines are concerned. The illustration shows the jacks encased in a dust-proof case on the front and rear axles. In practical use, these will be attached behind the axles, out of sight. Jacks are attached at four points of the car. When it is desired to raise a particular wheel, the indicator knob is turned to the number corresponding to the "right rear," "left front," etc., as may be necessary. The desired jack falls into place. Oil is then forced into the hydraulic cylinder, thru the line from the oil reservoir by engaging the clutch attached to the pump, thus extending the jack and raising the car. The jack may be distended by either opening a by-pass or by springs as indicated on the illustration.

The car may be entirely raised from the floor by turning the indicator knob to a fixt point, thereby opening the four by-passes after which the car may be blocked up, in its jacked up position, making it impossible to move the car and also taking all strain off of the tires. Both systems are controlled by safety valves and are practically fool-proof.

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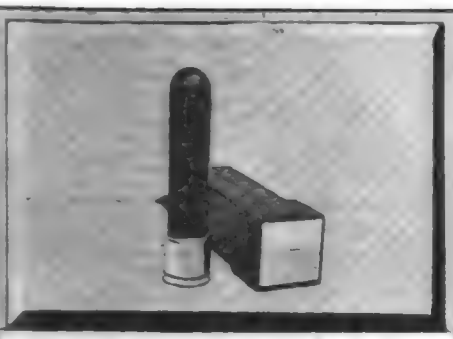
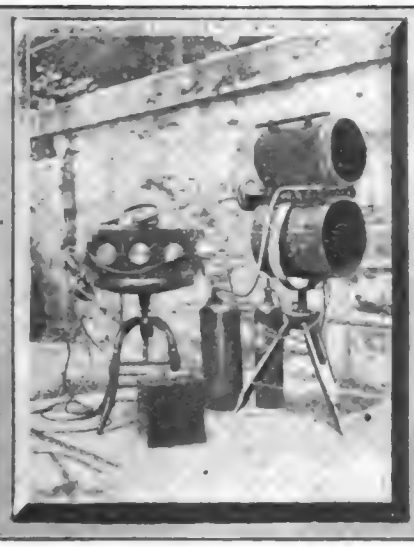
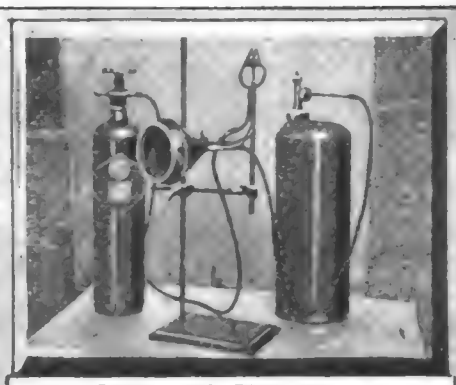
New Light-Sensitive Cell



Above—The Appearance of the Latest Photo-Electric Cell Sensitive to Various Degrees of Light and Known as the "Thalofide" Cell, Perfected by Theodore W. Case, an American Inventor. It Is Far Superior to the Selenium Cell and Fills All the Purposes and Requirements of That Well-Known Light-Responsive Device. With a Relay or Telephone Light Telephony May Be Carried On.





The Center and Right-Hand Views Show Apparatus Used by Mr. Case in Talking Over a Two-Mile Range by Light-Ray Telephony. The Talking Set Used, Together with Reflector and Gas Tanks, Are Shown at the Right, While a Complete Transmitter and Receiver Appear in the Center Photo.

BY means of the new *thalofide cell,* here illustrated and described, it is interesting to know that Theodore W. Case has talked by means of a light beam, using this cell as the receiver, over a distance of six miles. For this purpose he developt a new sending light jet, which consists of a central nozzle burning acetylene gas with two opposing and slightly raised jets for oxygen. When the central jet is turned on, the gas is adjusted so as to produce a flame about 4 inches in height. As soon as the oxygen jets are turned on, it reduces this long central flame to an extremely intense triangular spot of light, approximately ¼ inch on the side.

The talking funnel is put in on the acetylene line and varies the intensity according to the pressure changes produced by the voice. This is now ideal for placing at the focus of a sending projector. On the 6-mile talking tests this jet was used at the focus of a 16-inch projector, and the thalofide cell at the focus of a 16-inch receiving mirror, in conjunction with a straight two-step audion hook-up for amplification. This range can, of course, be materially lengthened by increasing the size of the receiving mirror. One of the photographs here reproduced shows the new *talking* set developed by the Case Laboratory.

Mr. Case recently publisht a list of substances which were examined for change of resistance under the influence of light. This work was continued, altho no substance at that time had been found which compared in sensitivity with selenium. Most of the new combinations found, however, indicated that sulfides would be the most promising field for future work.

On October 2, 1917, the author found that *thallium sulfide* (fused) showed a slight change of resistance under the influence of light.

After two years of research upon this compound, very sensitive cells have been made to which the name *thalofide cell* has been given, indicating that the present sensitive substance is composed of thallium, oxygen and sulfur. The thalofide material after careful preparation is first fused on a ¾-inch quartz [illegible] then it is placed in an evacuated tube. The effect of the vacuum is to increase the sensitivity of the element from three to five times and also preserve its life by preventing oxidation. Several hundred of these cells are now over a year old and have not lost any of their initial sensitiveness.

By means of the Wratten filters, it was found that the blue and violet rays had a deleterious effect on the element in that after rather strong exposure, the resistance was somewhat permanently lowered by this upper part of the spectrum, and the recovery period after exposure was much slower.

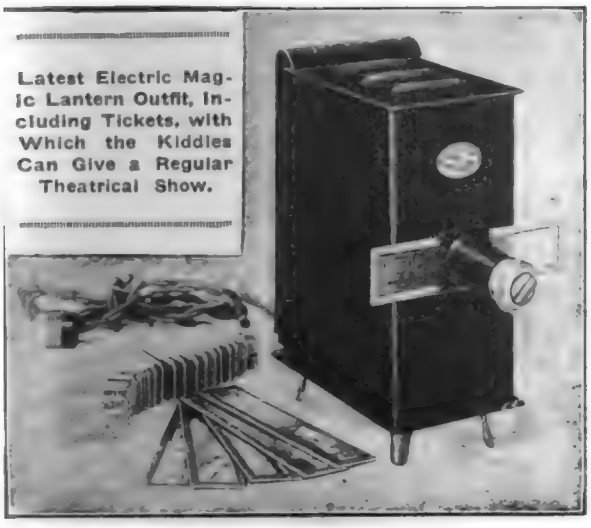
(*Continued on page* 264)

Electric Magic Lantern

Here is one of the very latest innovations in the line of electric toys which will tickle the heart of any boy or girl who happens to be presented with one. It is nothing more or less than a complete electric magic lantern outfit with admission tickets, 'n everythin'! With this equipment, comprising the picture slides, attachment cord and tickets, the kiddies can give a real show just like the managers of the "Nickelettes" down Main Street. A similar machine is made with motion picture equipment and various small size films are furnisht with these outfits instead of slides.

Many ingenious ideas will suggest themselves to children who are the possessors of the electric magic lantern of this type, and not only are such devices as this of particular amusement value, but they are also very instructive. It seems to us that before many more moons have past, that some of the educational toy houses will awake to this fact and turn out some really instructive slides, instead of the average batch of monkey pictures which have accompanied this outfit in the past. Owing to the poor quality of the pictures, the sale of the magic lantern has until recently been greatly curtailed. Children have much keener minds than the adult usually supposes, and they tire very quickly of comic views and other similar pictures.

This toy would undoubtedly make an ideal gift for any child,—not alone because of its educational value, but also because of the amusement it affords. A parent can make no wiser selection than this instructive gift,—which is certain to please the most particular children.



Latest Electric Magic Lantern Outfit, Including Tickets, with Which the Kiddies Can Give a Regular Theatrical Show.

Electric Tie Tamper

The accompanying picture shows one of the latest devices perfected for railway building—the electric tie tamper. It is supplied with current thru a flexible cable connected to the nearest current supply or else to a dynamo driven by a portable gasoline engine.

Electric Tie Tamper in Actual Use.

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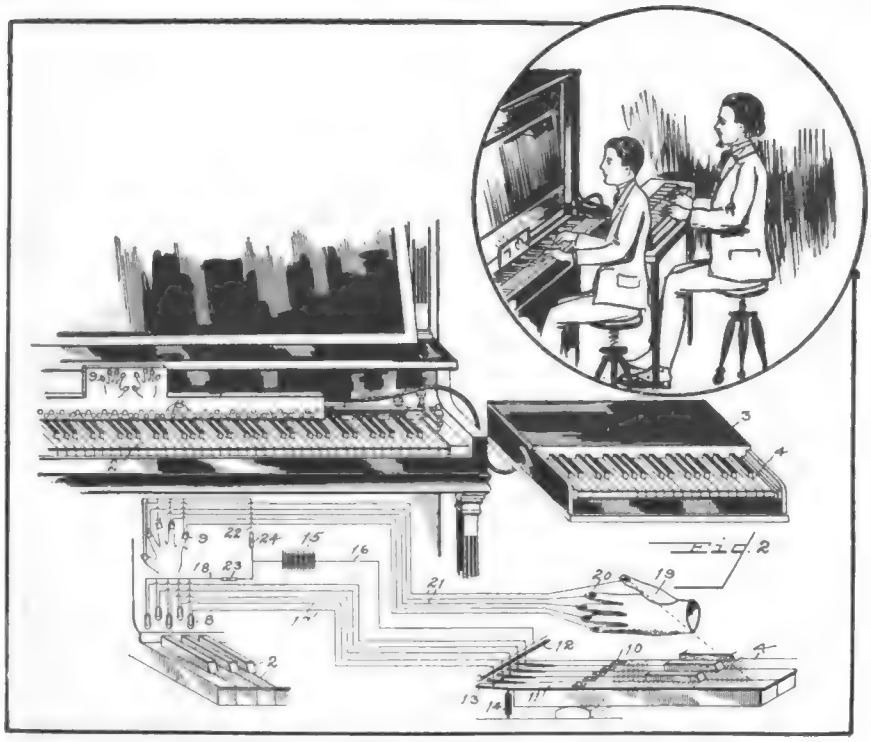
Electrical Indicator Shows Notes to Play

THE clever electrical indicating device here illustrated relates to the musical art, and particularly to an indicating apparatus for instructing the novice to perform upon a musical instrument by indicating to him in predetermined sequence and for proper intervals of time, in accordance with the composition to be played, the proper operative element to be manipulated, and, moreover, the exact digit to be employed.

These indications are accomplisht by means of visual signals energized in proper succession by the master or instructor who performs the operation and movement necessary to a proper rendering of the composition upon a clavier or master instrument removed from the student's musical instrument.

The musical instrument to be played is provided with a series of visual signals correlated with the operative or playing elements thereof, there being one such signal for each element, and a second series of signals corresponding to the digits of the player to indicate with which digit the signaled operative or playing element should be manipulated. These signals are controlled by the manipulation of the corresponding element of the master or instructor's instrument.



The Object of This Electrical Signaling Scheme Is to Cause the Signal Lamps to Light Up Along the Keyboard, So That the Notes Played by the Instructor Are Directly Indicated to the Pupil—And Not Only Each Note Clearly Shown In This Manner, But Also the Fingers or Digits Which Are to Be Used In Playing the Specific Notes. The System Is Also Adaptable to the Playing of the Violin or Other Stringed Instrument, As Well As Wind and Other Musical Instruments.

The illustration shows a piano of ordinary construction with the usual keyboard. Located at the side of the piano is the primary or master's instrument, which comprises a clavier corresponding with the keyboard of the piano. The manipulation of the keys of the primary or master's instrument, however, produces no sound, but they serve only to operate certain signals. The keys of the primary instrument are of a size substantially equal to those of the piano and are mounted in a similar manner. A second operative instrument may be used in lieu of the silent instrument or clavier. Transversely disposed above the keys of the piano is a bar, supported on its opposite ends by extendible arms, which engage the cheek blocks at the opposite ends of the keyboard. To enable the bar to be located in proper adjustment in relation with the keys, adjusting screws are provided. Carried in the bar are a series of *signal lamps, one lamp for each key or operative or playing element.* In order to distinguish the signals relating to the black keys from those relating to the white keys, the signals are preferably arranged in two tiers, the black signals being located in the upper tier and the white key signals in the lower tier. It is obvious, however, that instead of arranging the signals in two tiers, signal lamps of different colors may be employed to distinguish the signals corresponding to the white and black keys.

Immediately above the signals, corresponding with the keys of the instrument, are outlines of two hands upon each digit of which is located a signal to indicate the digit to be employed in operating the signaled key.

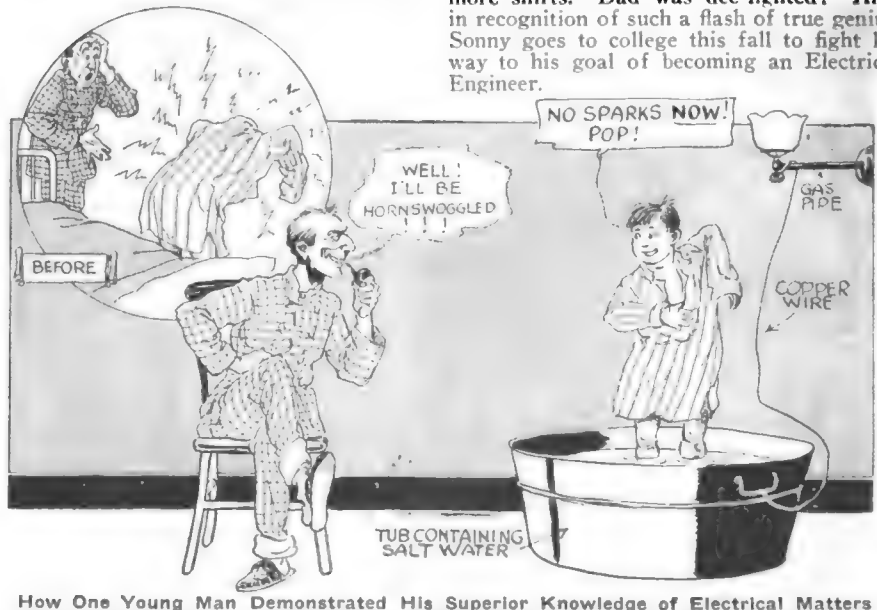
How He Won His "E. E." Course

A certain young man in the boundless Golden West of the good old U. S., had great aspirations to become an Electrical Engineer. His father did not entertain similar ideas, sad to say, but as time went along Sonny finally concocted several ingenious ideas by which to win his father's consent to attend college,—so that when he turned 21 years of age, he could hand out his little gilt-edged card, suitably inscribed with the degree of "E.E." after his cognomen. One experiment after another failed to make any impression on "Pop."

But as the cold weather season rolled around one winter, a peculiar and startling phenomenon was enacted before the O.M., and which happened thusly. Sonny, unwittingly demonstrated to his Dad, that he was possest, apparently, with more than the usual quota of natural electricity in his body. His new woolen shirts raised havoc every time he attempted to remove them, owing to the friction or other peculiar interacting electrical effect, which caused blue-white sparks to crackle and sizz around alarmingly, to say the least. Finally, things came to such a crisis that one night a new $5.00 woolen shirt went up in smoke and flames, as an extra heavy spark ignited the "whiskers" on the woolen shirt, when Sonny attempted to remove it. Of course, Dad was mad, but Sonny was glad,—for in the extreme rear of his cranium a new idea had been suddenly born.

Said he, "The O.M. sure is worried and I have a great idea which I thought up while reading that new book on "Experimental Electricity" which my Aunt sent me. The next time I fool around with them woolen shirts, I am going to *ground* myself in a tub of water, by connecting it to a gas pipe."

The experiment worked to perfection, and no more sparks occurred to set fire to any more shirts. Dad was dee-lighted! And, in recognition of such a flash of true genius, Sonny goes to college this fall to fight his way to his goal of becoming an Electrical Engineer.



How One Young Man Demonstrated His Superior Knowledge of Electrical Matters to Dad so as to Gain a College Course. Sparks Used to Jump All Around Him Whenever He Tried to Put On or Take Off a Woolen Shirt. He Finally "Grounded" Himself in a Tub of Water Connected to the Gas Pipe, and Demonstrated to Dad That He Was Indeed a "Second (?) Franklin."

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KLAXONS CLEAR FIRE STREETS.

Kwr—rrrrrrr—rr—r-r-r-r-!!! When you hear the piercing shriek of the raucous throated klaxons mounted on the lamp posts along the streets in Atlantic City, you want to shake-a-leg and clear the right of way, for quicker than you can say "Jack Robinson," you may find the motor-driven fire apparatus of that city, tearing down upon you at the rate of a mile a minute, bound for the scene of a conflagration.

Atlantic City has done much in helping to clear the way of playing children, pedestrians, as well as motor and wagon trucks, so as to keep up the good work of the fire department of that municipality in making record trips to fires. These powerful electric horns are placed at intervals of two blocks along the main thorofares, and they are actuated thru the electric fire alarm box circuits, connected to the lamp posts on which they are mounted.

As soon as an alarm of fire is turned in to fire headquarters, all of the horns along the road, followed by the apparatus from the station to the scene of the fire, begin blowing. Imagine how much better this idea is than to depend upon gongs or sirens on the fire apparatus clearing the street a small distance ahead of it, as it comes tearing down the avenue at from 40 to 50 miles an hour!

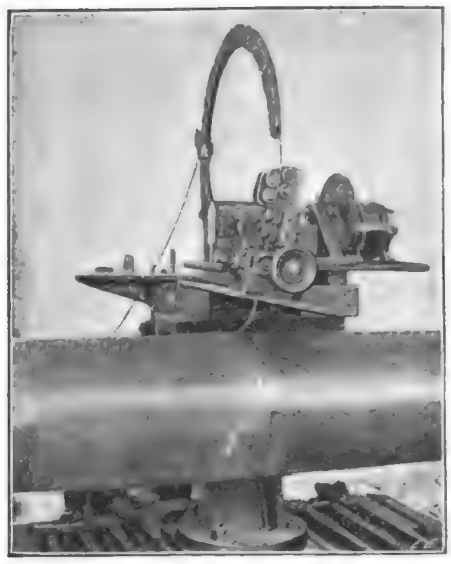
In Atlantic City, They Have Installed the Greatest Idea You Ever Saw In Electric Fire Alarms to Warn the Public That the Fire Apparatus Will Shortly Be Tearing Down the Street. Along the Way Which the Apparatus Will Follow, Powerful Electric Klaxons Blast Forth the Warning.

We all like to see the fire engines and hook and ladder trucks go dashing to the scene of a fire, but it is not all romance and glory for the firemen—nor for some of the pedestrians on the street either, for in a number of instances, the driver of a fire engine has had to choose between running his machine into an elevated railroad pillar or into a glass store window, in order to save pedestrians from being run down and killed—or else take a chance on keeping to the right of way and possibly missing them.

An ounce of prevention is worth a pound of cure, and this city is certainly to be commended for establishing such a useful and humanitarian device as this, which should not only save many lives, but should also expedite the movement of fire appartus over city streets, especially in greatly congested sections of large cities.

NEW AUTOMATIC ARC WELDER.

THE operation known as arc welding is made possible by the fact that when a live circuit is broken, an arc is formed between the two ends at the break.



This Arc Welder Is Adaptable to Any Form of Weld, from Butt Welds of Plates to Rebuilding Worn, or Inaccurately Turned Shafts, as Here Shown.

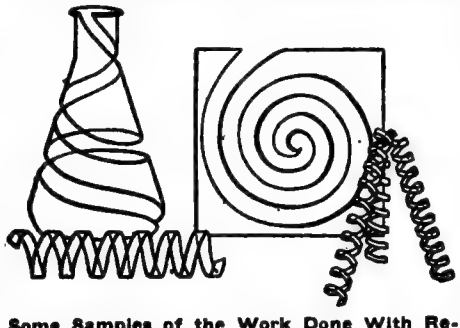
As long as these two ends are maintained at a proper distance from each other, this arc will continue to burn, with such an intense heat that one of the ends of the circuit is melted off, some of it being deposited on the other. *In arc welding this is accomplished by making the wire electrode one end of the broken circuit, and the object to be welded, the other.* The arc is allowed to become long enough to melt the wire electrode but not so long as to permit air to mingle with the metal in transit, and oxidize it, so that metal in a pure condition is deposited on the work.

This is accomplisht automatically in the new welding device here illustrated. This welder, for use with the regular welding set, is designed to take the place of the hand controlled electrode. It consists of a pair of rollers, called feed rollers, driven by a small direct current motor, which draw in, and deliver at the arc a steady supply of wire, and automatically maintain the best working distance. The whole is controlled from a small panel.

The welding head is supported on a radial arm with a certain amount of hand regulated adjustment, and consists of a steel body carrying feed rolls and straightening rolls which are both adjustable for various sizes of wire.

WONDERFUL NEW GLASS CUTTER.

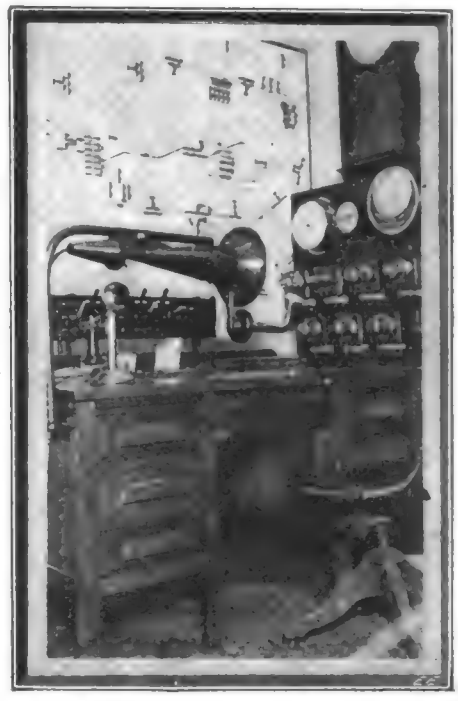
Attach by means of rubber tubing to your gas supply, adjust flow until flame strikes back, and when sufficiently hot use cutter to lead crack in glass in any direction. A deep file mark will serve as a starting point for the crack. That's all there is to it with the new glass cutter here illustrated. The second illustration shows some of the wonderful work accomplisht with this simple glass cutter. It was devised by Lieut. K. H. Parker, formerly of William Jewell College, and the instrument is available on the market at a nominal price. The cutter shown is intended for illuminating gas only. It can be supplied for use with natural or gasoline gas.



Some Samples of the Work Done With Remarkably Simple New Glass Cutter Which Operates on Gas.

"HIGH POWER" TELEPHONE FOR LOAD DISPATCHERS.

The San Joaquin Light & Power Corporation of Fresno, California, some time ago adopted a high power telephone known as the "Wonderphone" for load dispatching on their private telephone system. Their telephone lines, like those of many other power companies, are carried along on the same pole lines with high voltage transmission circuits, and are more or less subject to inductive interference. The use of repeating coils and relays such as used by the commercial telephone companies is out of the question on such lines, owing to frequent high voltage disturbances due to transmission line failures.



A High-power, Loud-speaking Telephone Used by the Load Dispatcher of the San Joaquin Light and Power Corporation at Fresno, Cal.

The high power telephone has proven a decided success in overcoming these difficulties. It is simply a telephone set, on a big scale, designed to transmit a greater volume of power and to greatly amplify the received energy. With this set it is possible to talk several hundred miles, which would not be possible with an ordinary telephone apparatus. The energy for the set is an eight-volt storage battery.

The set has other advantageous features. It gives the dispatcher free use of both hands to arrange his papers and make notes. Since the receiver talks out loud he does not have to hold his ear close down to it and is thus free from severe "raps in the ear". Also, not having to hold any part of the apparatus he is not subject to electrical shocks.—R. C. DENNY.

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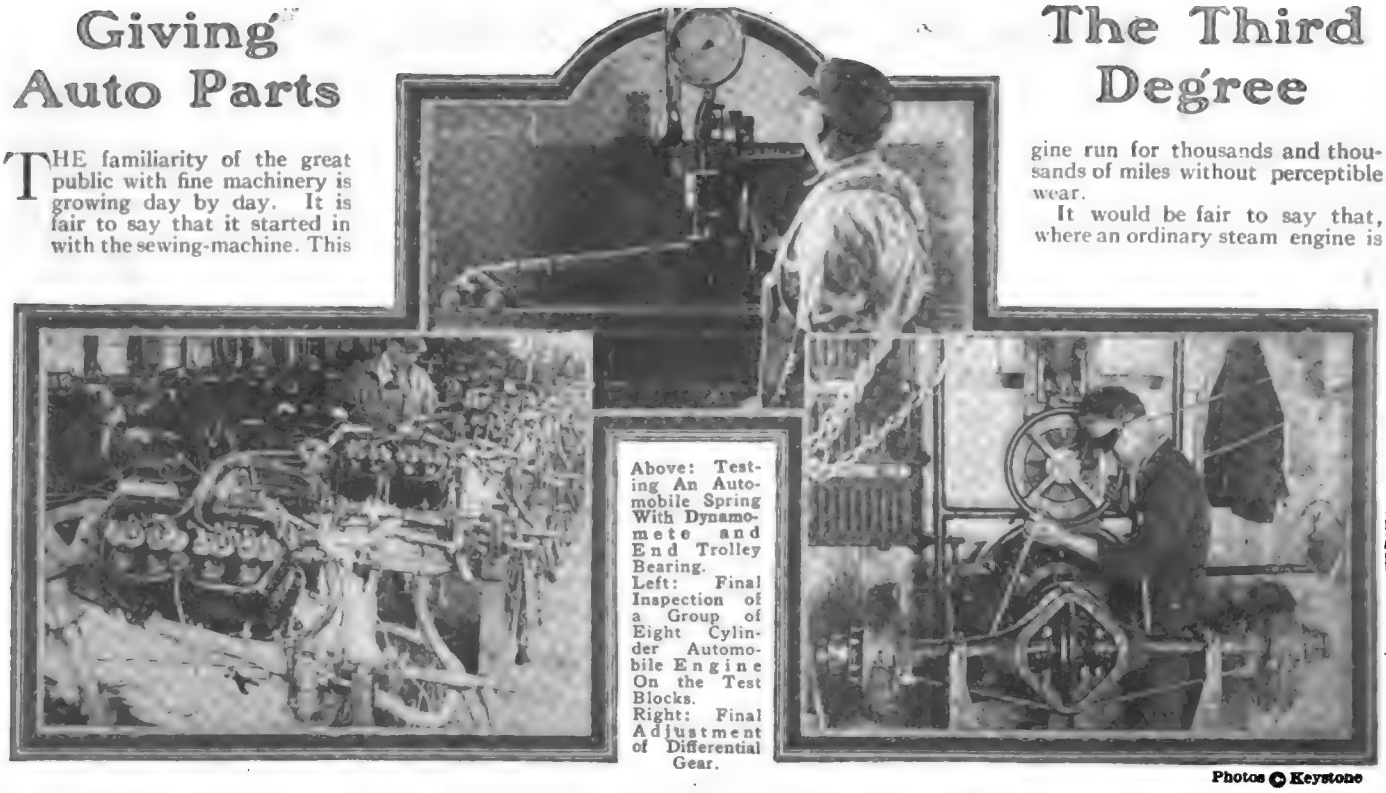
Giving Auto Parts The Third Degree

THE familiarity of the great public with fine machinery is growing day by day. It is fair to say that it started in with the sewing-machine. This is a mechanism cared for by presumable non-mechanics and yet kept in successful operation. This certainly familiarized many unmechanical minds with the ways and iniquities of mechanical things. But the automobile has had a vastly greater effect. Almost everybody knows how to run an automobile, or thinks he does.

And it is very curious to note the development the automobile has taken. It is constructed most carefully. The most elaborate precautions are used in the selection of the different steels, in the testing of the different parts, in their adjustments, while thruout the effort to make it free from trouble is shown in the casing or enclosing of the critical parts. Thus, as far as possible, the engine is cased in and by splash feed or otherwise is kept over-lubricated, the effect of which is that the cylinders and rings last for what may be called an incredible period of service. No personal touch is needed by the engine, with the exception of very few adjustments. Then, if we come to the transmission which carries the power from the engine to the rear axle, including the change gears and the somewhat complicated differential, we find it all cased in steel housings, so that the gears cannot be reached without considerable dissembling. A great excess of lubricant is put into the change-gear box and into the differential-case so that the parts like the engine run for thousands and thousands of miles without perceptible wear.

It would be fair to say that, where an ordinary steam engine is taken care of by its engineer, and where a machine tool is oiled and has its operations carefully watched by the mechanic in charge, the carefully constructed and accurately adjusted mechanism of automobiles has to look after itself, and all that saves it is the excessive lubrication to which it is submitted.

Our illustrations give some idea of the testing and inspecting of automobile parts; the testing out of a spring with a heavy dynamometer is shown in the upper cut; the inspection of a group of eight-cylinder engines and the inspection and adjustment of a differential are shown in the other cuts.

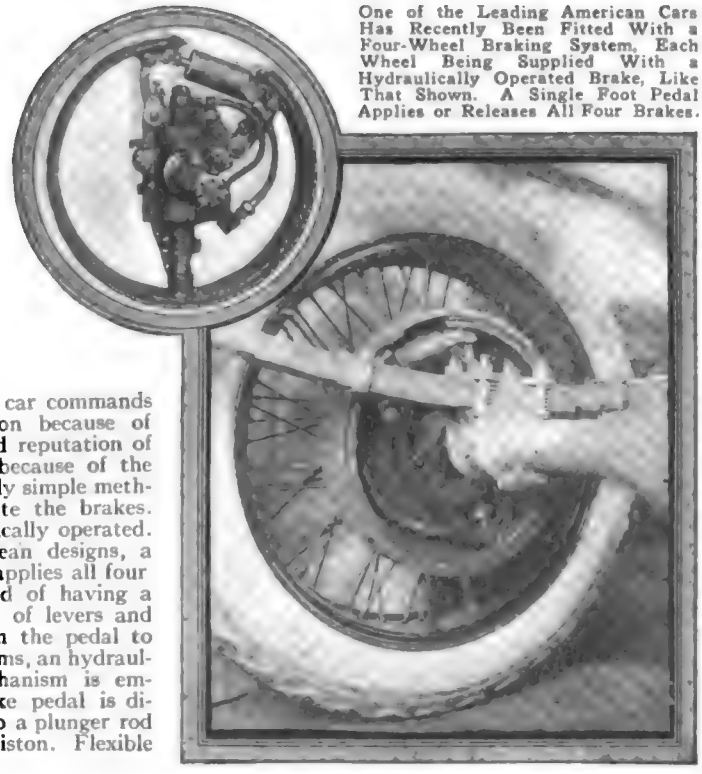


Above: Testing An Automobile Spring With Dynamometer and End Trolley Bearing. Left: Final Inspection of a Group of Eight Cylinder Automobile Engine On the Test Blocks. Right: Final Adjustment of Differential Gear.

Photos © Keystone

Hydraulic Brakes for Motor Cars

CARS with brakes on all four wheels have been built in Europe for years by at least one prominent maker and since the war several other manufacturers have taken up the idea. Quite recently a fine American car has been announced with a four-wheel braking system. The car commands particular attention because of the experience and reputation of its designer and because of the novel but extremely simple method used to actuate the brakes. They are hydraulically operated. As in the European designs, a single foot pedal applies all four brakes but instead of having a complicated array of levers and rods running from the pedal to the four brake drums, an hydraulic actuating mechanism is employed. The brake pedal is directly connected to a plunger rod which actuates a piston. Flexible metal tubes run from this cylinder to the four brakes. Each brake has a small cylinder and plunger which are placed between the ends of the expanding brake shoe. Pressure on the pedal forces heavy oil from the main cylinder, thru the four tubes to the brake cylinders where the pressure expands the shoes and applies the brakes. When the foot is removed from the pedal a spring pulls it and the main plunger back into its original position. Each brake is then drawn out of contact with its drum by means of a spring inside of the brake plunger cylinder.



One of the Leading American Cars Has Recently Been Fitted With a Four-Wheel Braking System, Each Wheel Being Supplied With a Hydraulically Operated Brake, Like That Shown. A Single Foot Pedal Applies or Releases All Four Brakes.

The plunger cylinder is connected directly to one brake shoe end and the plunger itself to the other brake shoe end; there is no intermediate linkage. The plunger and cylinder, therefore, take the place of the usual cam employed with expanding brakes.

One of the principal reasons for using the hydraulic system is its simplicity. Obviously it is difficult to work out a brake linkage which will function in spite of the swinging of the front wheels to right and left as the car is steered.

Another advantage of the hydraulic method is that it provides perfect brake equalization. Mechanical brake equalizing mechanisms do not function well, and with four brakes to equalize instead of two the problem becomes twice as difficult as before.

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Practical Chemical Experiments

By PROF. FLOYD L. DARROW

IN line with the experiments described in the previous article in this series the detection of the common food adulterants will prove an interesting and valuable continuation of the work. In the last issue we took up a somewhat thoro examination of milk and we shall begin this number with a series of tests on butter.

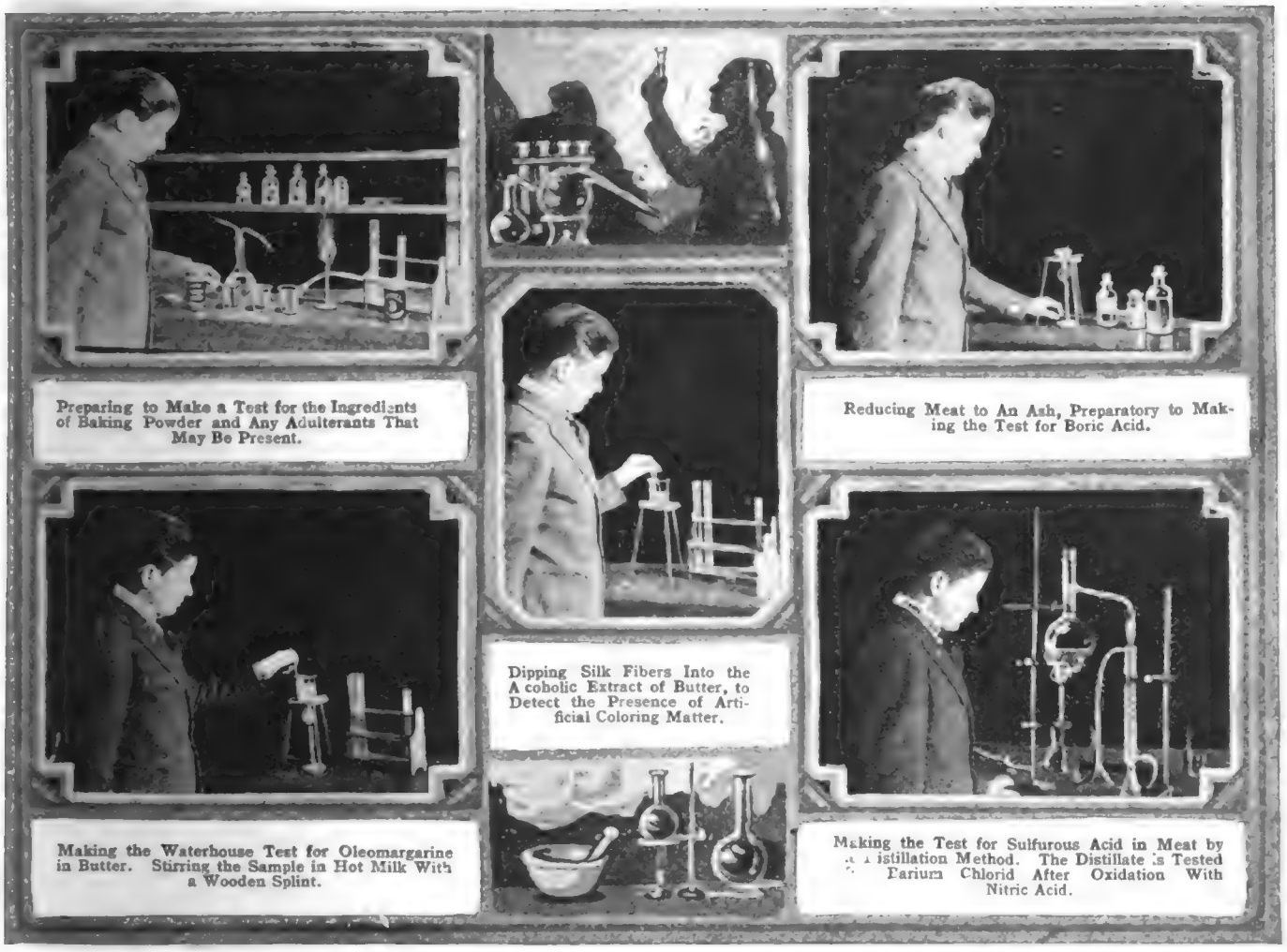
fibers will be colored, but normal butter coloring matter will not dissolve when thus treated and no color will appear.

Saffron: The presence of saffron may be told by the addition of nitric or hydrochloric acid to the alcoholic extract. Nitric acid gives a green color and hydrochloric acid a red color.

Turmeric: If we add ammonia to the

the beaker in a dish of ice water and continue to stir the mixture until the fat solidifies.

If the sample is butter fat, it cannot be collected into a lump but will remain diffused in the milk in an emulsified state, but if it is oleomargarine, it will clot and gather into a solid mass. If it is renovated butter, it will collect as a film on the surface of the milk.



Preparing to Make a Test for the Ingredients of Baking Powder and Any Adulterants That May Be Present.

Reducing Meat to An Ash, Preparatory to Making the Test for Boric Acid.

Dipping Silk Fibers Into the Alcoholic Extract of Butter, to Detect the Presence of Artificial Coloring Matter.

Making the Waterhouse Test for Oleomargarine in Butter. Stirring the Sample in Hot Milk With a Wooden Splint.

Making the Test for Sulfurous Acid in Meat by the Distillation Method. The Distillate is Tested With Barium Chlorid After Oxidation With Nitric Acid.

Butter

Coloring Matter: Add 10 cc. of carbon disulfid, a little at a time and with frequent shaking, to 75 cc. of alcohol. Place 5 grams of butter in a large test tube add 25 cc. of the above mixture and shake thoroly. Allow this to stand for sometime. The alcohol dissolves out any artificial colors that may be present and rises to the top, while the carbon disulfid dissolves the fatty matter and settles to the bottom.

Annatto: To determine the presence of annatto, evaporate a portion of the alcohol extract to dryness and add sulfuric acid to the residue. A greenish-blue color shows annatto, while a pink indicates the presence of a coal-tar dye.

Coal-Tar Colors: Acidify a diluted portion of the alcohol extract with a little hydrochloric acid. In this place pieces of silk or wool fiber and boil. If coal coal tar dyes are present these alcohol extract and obtain a brown color, a coloring substance known as turmeric is indicated.

Marigold: If marigold is present, silver nitrat solution added to the extract will give a black color.

Renovated Butter: The simplest test, for distinguishing between renovated butter and the pure fresh article, is to heat a little of it in an iron spoon or porcelain dish. If it is renovated butter, it will sputter, but will not foam much. By making a comparison with butter known to be fresh, the difference will be immediately seen.

Oleomargarine: In a large test tube place 50 cc. of sweet milk and shake thoroly. Then heat nearly to boiling in a small beaker. Add from 3 to 4 grams of the sample to be tested for oleomargine and for renovated butter, and stir with a small wooden stick until all of the fat has been melted. Then place

Cottonseed Oil: Cottonseed oil is sometimes used as an adulterant of butter. Its presence can be shown as follows: Add 1 gram of sulfur to 10 cc. of carbon disulfid and shake until it has dissolved. Then add an equal volume of amyl alcohol. Mix 5 cc. of this reagent with an equal volume of the melted butter in a test tube. Close the test tube with a cotton stopper and set it in a beaker containing a saturated solution of common salt. Place the beaker over a Bunsen burner and boil for 15 minutes. If cottonseed oil is present there will be a deep red or orange color in the contents of the test tube, but if it is absent there will be little or no color. See Figure 1.

Meats—Preservatives

Potassium Nitrat: One of the most important uses of potassium nitrat, or saltpeter is in the preservation of corned

(*Continued on page 282*)

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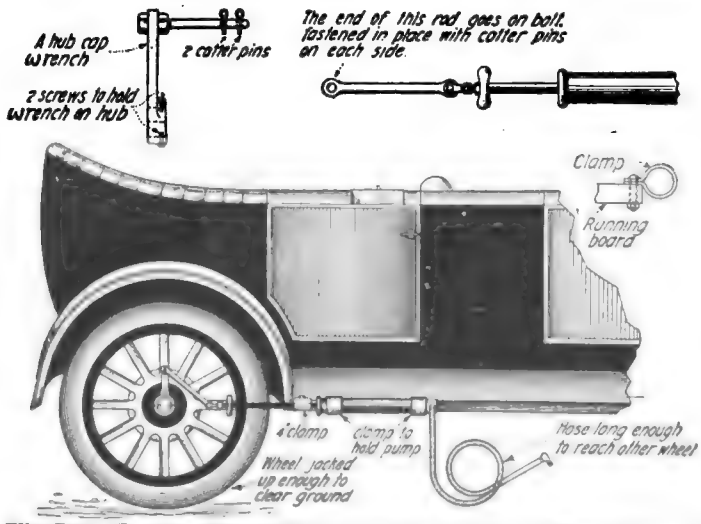
MOTOR HINTS

First Prize $25.00

A SIMPLE TIRE PUMPING RIG FOR YOUR AUTOMOBILE.

A hub-cap wrench is drilled to receive set screws to hold it on the hub of one


A hub cap wrench
2 cotter pins
2 screws to hold wrench on hub
The end of this rod goes on bolt, fastened in place with cotter pins on each side.
Clamp
Running board
4" clamp
clamp to hold pump
Hose long enough to reach other wheel
Wheel jacked up enough to clear ground

Why Pump Up Your Tires and Take All the Pleasure Out of a Pleasant Motor Car Ride, When You Can Obtain Free Air by Simply Rigging Up Your Hand Pump to One of the Rear Wheels in the Manner Shown? When the Wheel Is Jacked Up It Will Revolve and Actuate the Every-day Hand Pump in the Manner Apparent.

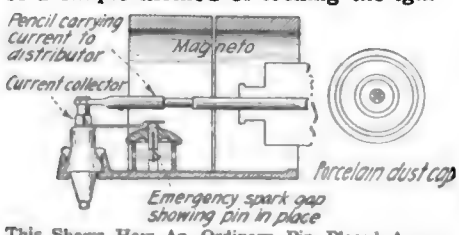
of the rear wheels. A pitman or connecting rod connects from the outer end of the hub-cap wrench to the end of the handle of the ordinary foot pump. This is really all there is to it. The foot pump is clamped to the running board, which seems to have been placed there just for this purpose. The stiffness of the piston rod of the pump is relied on to take care of the parallel motion because it is obvious, that it would occasion considerable complication to put on a slide rest. One of the wheels only is jacked up just as if for changing a tire. The other wheel rests on the ground and by the action of the differential, the free wheel turns rapidly and two or three minutes will pump the biggest tire. A minute or less will suffice for the tire of an every day automobile. It is perfectly obvious that, it is advisable to have this attachment for both rear wheels, otherwise the rim and tire would have to be removed for pumping the active wheel tire. The reverse gear may be used on one side and the forward gear on the other.

Contributed by
LAURENCE SAUNDERS.

Second Prize $15.00

LOCKING THE AUTOMOBILE WITH A COMMON PIN.

Illustrations in detail are here shown of a simple method of locking the igni-



This Shows How An Ordinary Pin Placed Across the Safety Spark Gap on a High Tension Magneto Will Prevent the Car From Being Started and Will Fool Many a Person, Unless They Have a Great Deal of Time in Which to Examine the Ignition System and Locate the Trouble.

tion of automobiles equipt with high tension magnetos, to prevent starting the engine, when the car is left unattended.

The idea is simply to short-circuit the emergency or safety spark gap on the magneto. Using the Bosch magneto as an example, all that is necessary to effectively lock ignition is a common pin.

Referring to the illustration, the upper electrode of the emergency spark gap is set in a porcelain dust cap, which is readily removable. This electrode is slotted into four segments. If the cap is removed and a common pin inserted in the center of the electrode, between the segments, it will fit snugly. When the cap is replaced the pin grounds the spark gap and prevents any current from reaching the spark plugs.

Pins can be conveniently carried in your coat lapel.

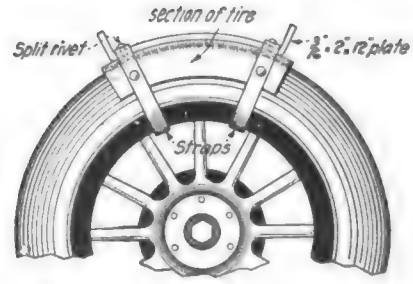
Contributed by
EDWARD E. KELLY.

Third Prize $10.00

A TRACTION SHOE FOR THE AUTO

To make a sand or mud-hook for pulling the auto from a hole or ditch, cut a 12" section from an old wagon or tire or similar piece of iron and after bending it to the shape, as illustrated, drill and rivet it to a section of a tire or casing from an old tire. Two straps or chains hold it in place on the wheel, as shown in drawing. Two or more of these shoes can be carried on a car and can be applied even tho the wheels are hub-deep in the mud.

Contributed by
JOHN McCARTHY.



Here Is a Simple and Extremely Effective Sand-or Mud-Hook Which Can Be Attached Quickly to One or Both Rear Wheels, Without Jacking Them Up. Two Leather Straps or Chains Hold the Shoe in Place.

NOTICE—CONTRIBUTORS ! ! !

We have not been at all satisfied with the class of suggestions we have been receiving lately in this department. Most of the devices that are suggested are very crude, and while some of them may be original, they are so impractical that not one in a hundred motorists would think of using or installing such a device. There is, however, one device that is needed badly which apparently has as yet not been invented. We refer to a device that would prevent stealing of motor cars. In the City of New York alone, there are stolen every day an average of 15 cars. The average for the entire country varies from between two to three hundred cars each and every day. This is a terrible loss and must be stopt at all cost.

For the next few months we will, therefore, give prizes only to such devices that prevent stealing of cars. We have publisht a few good ones in the past, but we feel sure that there are a good many others that should prevent thefts. It should be remembered always that motorists do not wish complicated and cumbersome devices; something that can be put in place quickly, and that can be removed just as quickly, is what is wanted. The device should, of course, always be secret so that the casual crook will not know how it is used. Variations of the device should be possible so that even after publishing such a device and giving it the fullest publicity, still it could be attached in such a way as to defy detection by the average man.—Editor.

FIRST PRIZE.....$25.00
SECOND PRIZE.....15.00
THIRD PRIZE.....10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

PRIMING ROD FOR "FORDS."

Herewith is a device which I have tried and found it to be successful. All Ford owners and drivers know that after cranking their cars on a cold morning, the motor has a tendency to stop, due to the fact that it has not warmed up enough to vaporize the gasoline. He then rushes back to the priming rod in front of his car, but generally arrives there too late, and has to crank his car again.

This can be remedied by boring a ⅛" hole in the upper inclined floor board, about a foot from the right end. Then get a steel rod ¼" in diam. and about 2½ ft. long. A second rod of the same size may be cut about 6" long. Fasten one end of it to the priming valve lever and the end to one end of the long rod, with a loop joint. A metal brace may be made of 1" material and fastened to the frame of car, for the short piece to slide on. Then cut the long rod off about 1½" above the floor board and the attachment is complete.

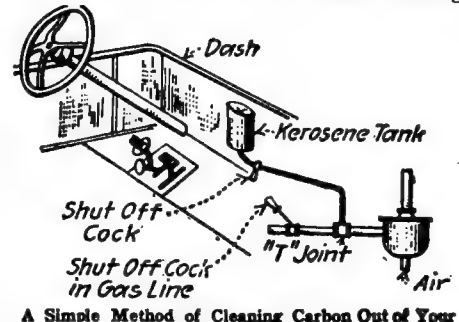
Contributed by MANLEY MITCHELL.

CLEANING MOTOR OF CARBON.

A one-half gallon kerosene tank is installed on the dash-board under the hood (on "Fords" it can be installed by the coil box) and connected to the gas line with a "T" joint; back of this joint are two shut-off cocks operated from the dash or instrument board, one to the gas line and one to the line from the auxiliary tank.

When the motor is warmed up and the driver comes to a down-hill run, the gas is shut off and the kerosene turned on. The kerosene loosens the carbon, which is expelled thru the exhaust.

If this be repeated every three hundred to four hundred miles, it will keep the motor free from carbon, and cut down running



A Simple Method of Cleaning Carbon Out of Your Cylinders With Kerosene.

and up-keep expenses. Costs $5.75 or less.

Contributed by V. C. UTTERBACK.

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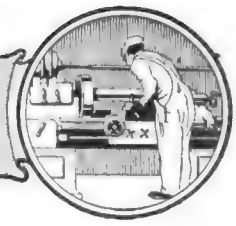
THE CONSTRUCTOR



Electric Power from a Spigot

A SHORT time ago we publisht an article on a new French invention, whereby a clever Parisian engineer lighted the electric lights in his home by means of a small water motor fastened to a charging dynamo connected with a storage battery, the water motor being operated by the water taken from the spigot every time the latter was opened. We have been flooded with inquiries from many of our readers, asking about the details of such a scheme and while we have not faith in the general adoption of this idea, for the reason that the water pressure would have to be increased in any given locality as soon as a number of people began to use this system, we present below a few electrical details which may be of interest to the experimenter, who may like to try out this arrangement.

Before going further it may be best to describe the action of a water motor, and particularly a large number of them, when connected to a central water distributing system in a city or township. When a load is put on to the water motor such as by belting a dynamo to it or otherwise, the speed of the motor will be reduced, and this is just where the reaction on the water system begins to take effect, for the water will no longer flow out thru the discharge of the water motor as freely as it did before the load was put on. In other words, the more load or the more electricity produced and "fed into the storage battery," the slower the water motor will turn in proportion, and thus a smaller quantity of water will pass thru the water motor. Now as we must, in order to realize the efficiency pointed out by the French engineer, en··vor to utilize for developing electric power the waste water as it passes from the spigot into the sink, we shou··, therefore, do all our cooking and ··ashing with the water coming from the turbine or water motor, as shown in the accompanying illustration. It will be seen, therefore, that there are more sides to this story than one, and that if 1,000 people for example, in a town of 5,000, all started to use these spigot electric lighting plants at one time, in order to rotate the water turbines at the desired speed the water pressure would have to be increased in the water mains, owing to the great resistance encountered at the various water outlets to which the dynamo turbines had been attached.

In other words to overcome the extra effort required by the water in endeavoring to pass thru the turbines and rotate them with their load at the same time. So if the water company had to do this in order to enable their customers to procure electric lights for their homes in this fashion, they would not get the lights for nothing, as so many have apparently imagined, but the water company would charge a considerably higher rate for the water service, owing to the fact that they had to raise the pressure in order to operate your plant as well as your neighbors' electric plants.

For those interested in this subject, however, in an experimental way, the

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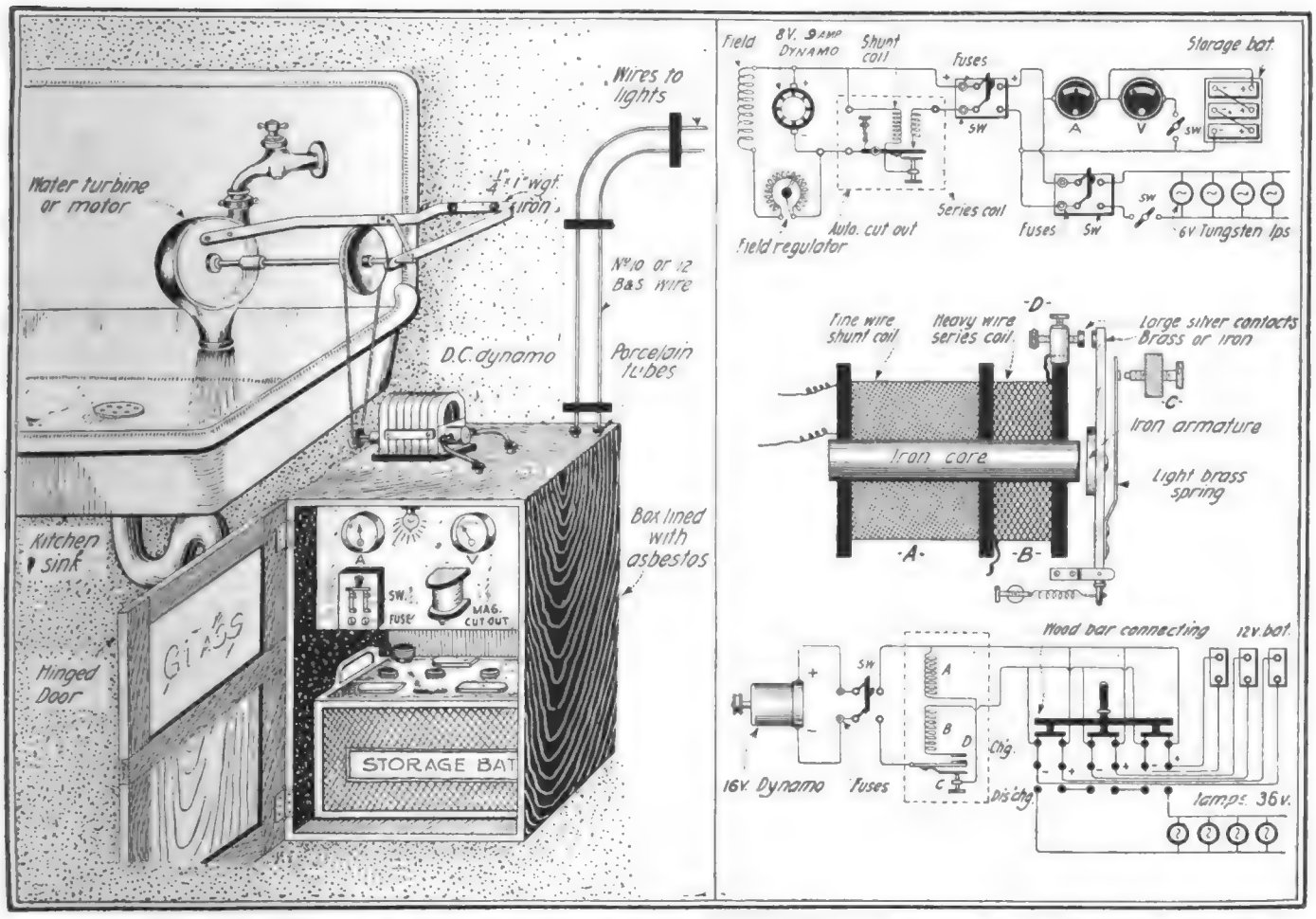

Details of a "Spigot-Electric" Generating and Storage Battery Plant Are Presented in the Drawing Above and in the Accompanying Text. It Would be Possible to Rig Up Several of These on Different Spigots, Each Dynamo Charging Either a "Common" Battery, or Else a Battery of Its Own

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How to Build A Violin

By HARRY L. GRAY

[The editors will be pleased to forward the addresses of concerns making violins, varnish and glue and also the address of those specializing in furnishing blue prints for violin makers, upon receipt of a stamped self-addressed envelope.—Editor's Note.]

AT first thought, the building of a violin might appear to be a difficult task, but as a matter of fact it is not. And by following these directions, a person of average ability can construct a violin that will be a surprise in appearance and tone quality, as I shall disclose some of my own secrets and dimensions which always result in a fine tone.

The tools actually needed are few: A gouge, scroll saw, a good plane, are about the most necessary ones. All tools should be kept perfectly sharp, otherwise, good work cannot be done.

The top of the violin is made from spruce, but white pine can also be used with good results, if it has a fine grain.

For the back, hard maple must be used. I do not know of any other suitable wood for this part. The sides and neck are also made of hard maple. The top and back are practically identical in size and thickness.

The size of the piece required is 16 inches long, 4½ inches wide, and 1¼ inches thick. Saw diagonally, as shown in Fig. 1A. This gives you two pieces one inch thick on one side, and ¼ inch thick on the other. Plane and glue together the two thick sides as shown in Fig. 1A, be sure that a perfect joint is made. The back is sometimes made in one piece, but never the top.

Only regular violin glue should be used; ordinary glue is worthless for violin work.

It will be necessary to rig up some sort of clamp to hold the top and back while glueing this first joint. However, I will leave this to the ingenuity of the builder.

After the glue has set 24 hours, remove the piece from the clamp, and plane one side flat and round off the other as in Fig. 1A. Then it can be seen whether the joint is perfect, and in case it is not, it should be sawed apart and re-glued before further work is done.

Of course it will be necessary to have patterns to work from, and if the builder does not care to buy these, and can borrow a violin, patterns can be made from it. All that will be needed is the outline of the back, and the "F" holes.

The top and back are then marked out from whatever patterns are to be used, and sawed out with a scroll saw. They should be cut out about a sixteenth larger than the finished size.

Then lay the piece down on the flat side, and with the gouge, work roughly to the shape. In order to get the right curves, take your model and make patterns as in Fig. 1C. These should be made from a piece about three thirty-seconds thick. Four of these are made, one lengthwise of the violin, and the others crosswise at each end and in the middle. The same are used for both top and back. These curves are then fitted to the piece you are working on, and worked down as near as possible with the gouge, after which it is scraped to a smooth surface and final shaping. Broken glass makes fine scrapers if regular scrapers are not to be had.

The piece is then sandpapered with No. 1 sandpaper until perfectly smooth, and cut to exact size from the pattern. Finish both top and back to this stage.

The "Purfling" should now be put in. The purfling appears as two thin black lines running around the edge. It is inlaid about one-sixteenth of an inch deep. Purfling must be bought ready for use; it is made in both wide and narrow style.

There is a special tool made for the purpose of cutting this groove for the purfling. See Fig. 6. However, the groove can be marked out with a pencil gage which one can easily rig up. Then with a thin and very sharp knife, cut carefully along the lines marked. Make a little chisel from an awl to plow out the groove. See Fig. 6. The groove should be narrower at the bottom; this will make a tight joint when the purfling is prest in. The purfling must be bent on the bending iron same as the sides, see Fig. 3A. It is then prest into the groove and glued in. Care should be taken to make the joints match perfectly, and in all, the purfling will probably be the hardest job on the whole violin. It is best to practise cutting a groove and making a joint on another piece before attempting the real job. After the glue has set, trim down flush with the rest of the surface.

Now we are ready to work out the inside of the top and back. This is the most important operation as regards the final tone, as such tone depends entirely on the wood being of the proper thickness.

To begin with, it will be necessary to cut from an ordinary piece of board, a recess which will exactly fit the piece you are

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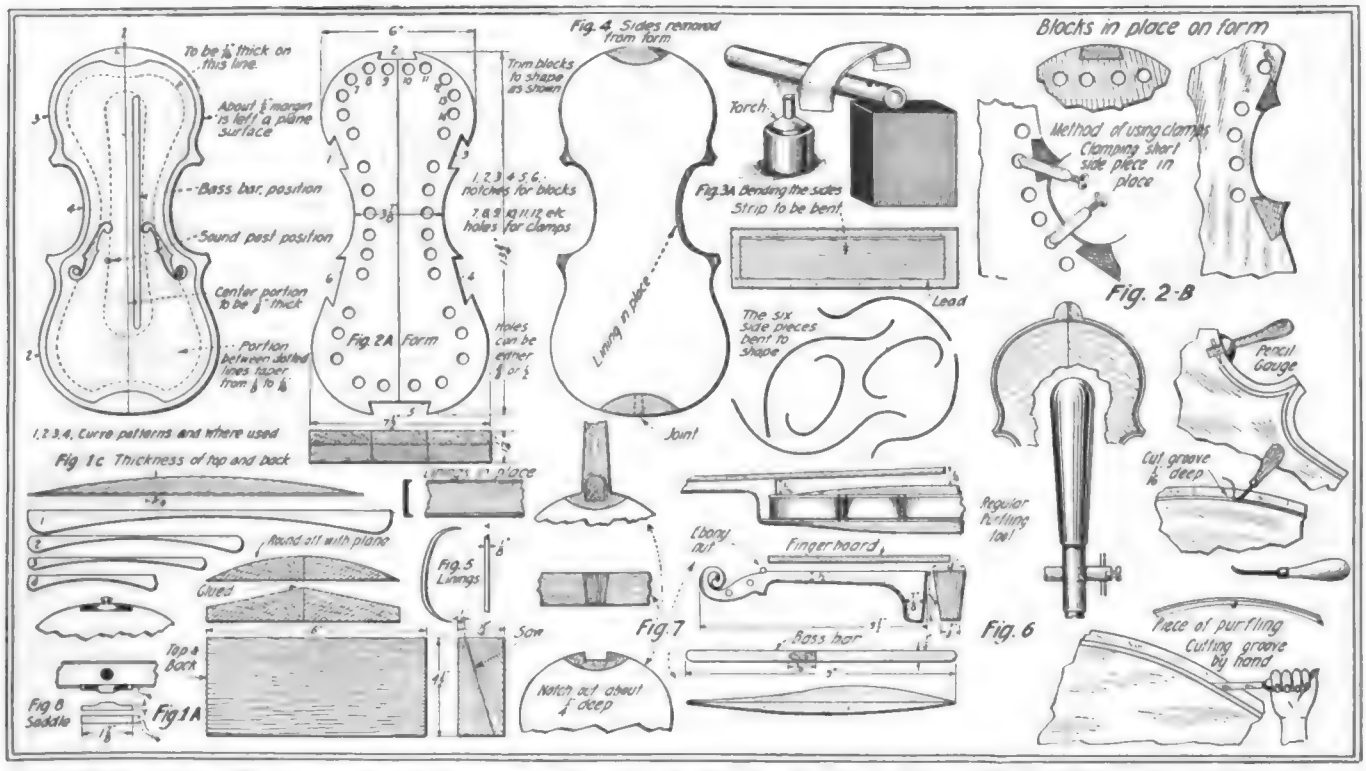
To be ⅛ thick on this line.
About ⅛ margin is left as a plane surface
Bass bar position
Sound post position
Center portion to be ⅜ thick
Portion between dotted lines taper from ⅜ to ⅛
1, 2, 3, 4, Curve patterns and where used
Fig 1c Thickness of top and back
Round all with plane
Glued
Top & Back
Fig 1A
Fig 8. Saddle
Fig. 2A Form
Trim blocks to shape as shown
1, 2, 3, 4, 5, 6, notches for blocks
7, 8, 9, 10, 11, 12, etc. holes for clamps
Holes can be either ⅜ or ½
Fig. 4. Sides removed from form
Lining in place
Joint
Torch
Fig. 3A Bending the sides
Strip to be bent
Lead
The six side pieces bent to shape
Blocks in place on form
Method of using clamps
Clamping short side piece in place
Fig. 2-B
Pencil Gouge
Cut groove ⅛ deep
Regular Purfling tool
Fig. 6
Piece of purfling
Cutting groove by hand
Fig. 5 Linings
Fig. 7
Ebony cut
Fingerboard
Bass bar
Notch cut about ⅛ deep

By the Aid of the Drawings Here Presented and the Accompanying Instructions by Mr. Gray, the Music Enthusiast Can Build Him or Herself a Very Creditable Violin. With a Little Practise and Using Good Wood a Very Superior Instrument May be Built.

ATTENTION! EXPERIMENTERS

The editors have received so many letters recently, asking for more "How-To-Make-It" and "Constructor" articles, that they have decided to give these enthusiasts their money's worth in the August number. In the August issue the How-To-Make-It, "Radio" and "Constructor Departments" will be greatly enlarged and a big bunch of snappy interesting articles will appear. Here's just a few samples:

An Electric Locator for ore, buried pipes or other metallic bodies with photographs and working drawings of the apparatus. By Victor H. Todd.

How to build a simple yet efficient air pump. By F. L. Abbott.

The construction of a small induction motor. By V. Ray Grabholz.

Construction of a gasoline blowpipe. By Fred W. Dickson.

A home-made refrigerating machine. By John E. Gorrell.

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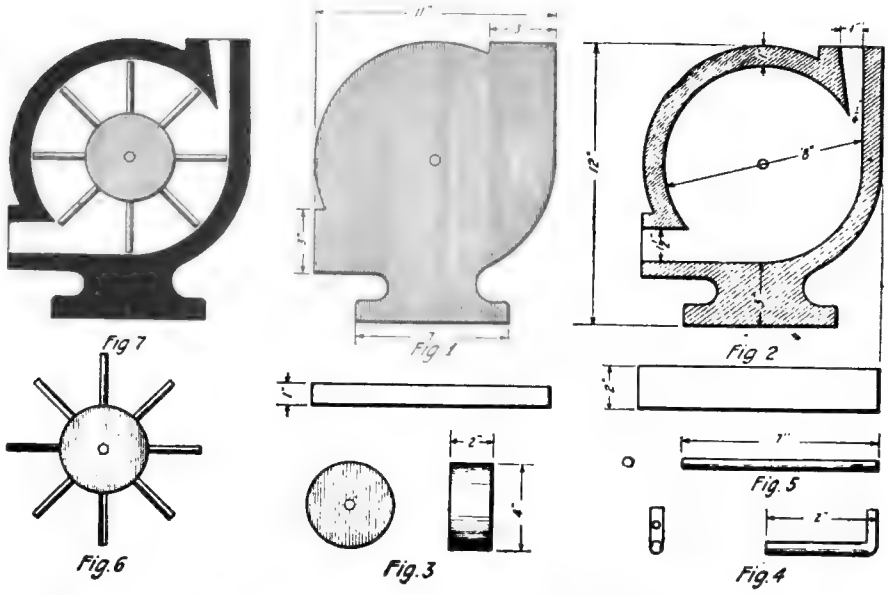
Home-Made Water Turbine

HERE is a description of a small water turbine which any experimenter can make. It is constructed entirely of wood and will be found to be very efficient. Before putting it together it is advisable to place the wood pieces in a tub of water and weight them, so that they stay completely submerged, whereupon no swelling will be noticed when the turbine is to be put into actual operation, and by cutting and carving the pieces, no further damage from warping of the wood will result. It is still better to heat them in paraffin wax until thoroly saturated.

The writer has also found that thoro impregnation of the wood with oil or other waterproof material, has a very beneficial effect.

From two pieces of maple - wood board, 12"x11"x1", cut the two end pieces of the turbine as shown in Fig. 1. Both should be cut clamped together so that they will be exactly even, and a hole is drilled exactly in the center of each for the shaft. From another piece of plank, 12"x11"x 2¼", cut a piece exactly the same shape and cut out the center portion to the shape of a circle as shown.



The Drawings Above Show How to Build a Small Water Turbine Suitable for Attachment to a Spigot, etc. Those Familiar With Foundry Work Will Probably Take Pleasure in Working Out the Design of a Somewhat More Efficient Turbine and Then Having the Various Parts Cast Either from Iron, Brass or White Metal. The Small Water Turbines Sold on the Market Have a Very Effective Rotating Member, the Buckets Being Hollow and Split in Two Halves, the Same as in the Pelton Water Wheel, the Design of Which Can Be Found in Any Text-Book on the Subject.

The center carefully hollowed out as shown, gives an 8" hole and at the top for the entrance of the water, a ¼" tapered hole is drilled and reamed which gradually becomes larger, so that the entrance is 1" in diameter, whereas the inner end remains ¼".

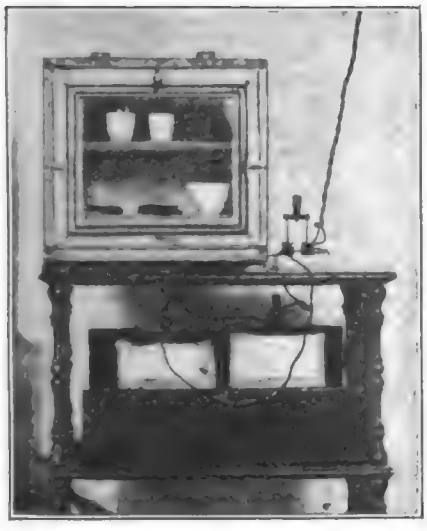
The outflow of water is thru a hole 1½" in diameter, drilled tangentially into the bottom of the case, whose construction has been clearly described.

We now have to make the rotor Fig. 6. Its basis is the block of wood, Fig. 3. On its perifery are secured eight pieces of iron, Fig. 4, for wings or paddles, 2" x 3" x ⅛."

An Electric Oven for the Laboratory

By J. J. SHANK

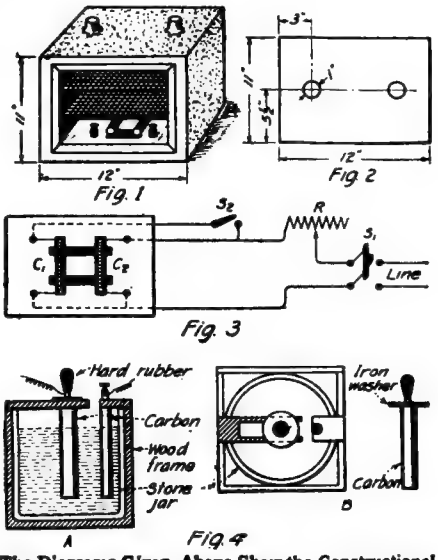
AN electric oven is one of the most useful things that one can have, especially if it is desired to do analytical work. They enable the operator to maintain steady temperatures at any point desired and for drying precipitates and preparations, they are almost indispensable. But the price is usually prohibitive to the amateur, and he must get along without one. Following is a description of how I built my own oven at a total cost of eight dollars. It has been in continuous use for several months and is giving me good service.



An Electric Oven for Use in the Laboratory Is Usually Considered Somewhat of a Luxury, but the Method of Building One Here Described by Mr. Shank Brings Such an Oven Within the Reach of Practically Every Experimenter's Pocketbook.

Secure a small, double walled oven, with a glass in the door, such as is used with an oil stove or gas plate. Mine is an Elgin Pet, No. 8. It measures eleven inches deep, eleven inches high, and twelve inches wide. Have a tinner put two small necks of sheet-iron on it as shown in the drawing. These are for thermometers or other fittings. Pack the space between the double walls with a stiff mixture of fire-clay and scrap asbestos, mixed to a stiff paste with water. Remove the glass from the oven door and pack the crevices with the mixture. Then press the glass back in place and fasten it. Be sure to pack all crevices well, as the steady temperatures desired can only be obtained with proper insulation. A piece of strong asbestos board is cut to fit the bottom and four binding posts are fastened to it as shown, for the heating coils. The two shelves are covered with 3/16-inch galvanized wire screen. This allows circulation and is a good support for crucibles and the like. The coils are fastened in place in the board and the wires led out at the bottom; be sure to insulate them from the oven. Their ends are fastened firmly to the binding posts and two porcelain cleats are placed under them to keep them raised from the bottom. This insures better circulation. Nail four pieces of wood together so as to form a square mould, one inch deep and thirteen inches on a side. Fill this with fireclay mixture and place the wires from the coils in it before it hardens, and set the oven on it. Fasten down with stove bolts before the clay dries. It is well to put the wires in glass tubes before putting them into the clay. The heating coils were made by the Majestic Electric Development Co., and are of the type used in their electric heaters, Majestic, No. 7. They cost two dollars apiece.

In the diagram S_1 is a d.p.d.t. switch on the line, S_2 is a s.p.s.t switch which enables the operator to cut out one of the coils. C_1 and C_2 are the coils and the black bars are the cleats. R is a variable resistance. At present I am using a water rheostat. Details of its construction are shown in figure 4. I used two half gallon jars (stoneware) connected in series. Sulfuric acid is added in small amount to water for the electrolyte.



The Diagrams Given Above Show the Constructional Details to Be Followed in Building the Electrically Heated Oven. It is Best Perhaps to Purchase the Electric Heating Units, altho They Can Be Made of Any Good Resistance Wire, Either of German Silver or Iron Wire, but It Is Best to Use a Special Non-Oxidizing Alloy Wire.

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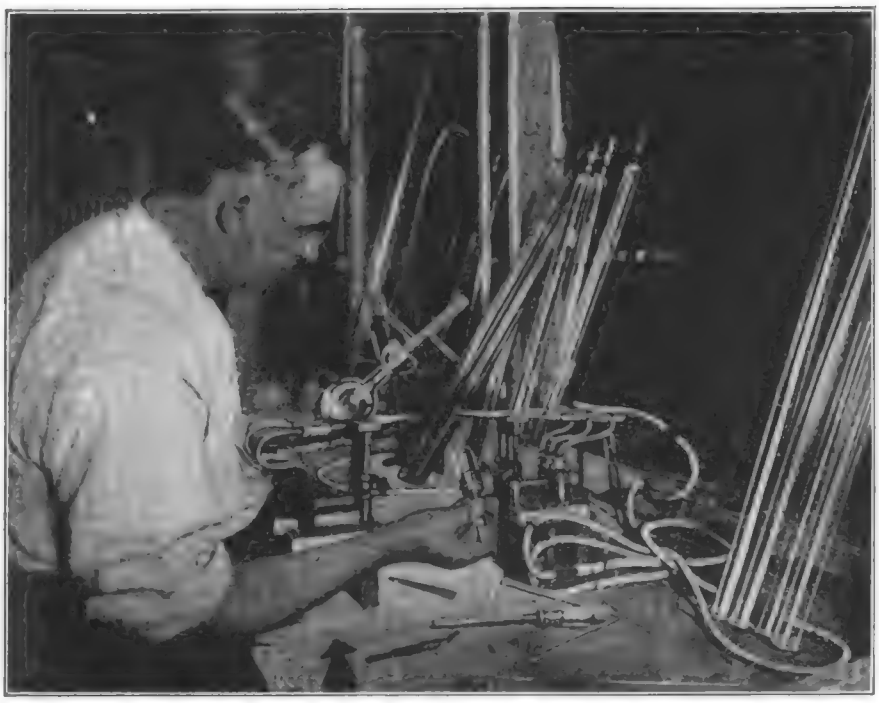
Manipulation of Glass

By CHARLES S. WOLFE



A Glass Blower at Work. The Special 6 Tip Burner Illustrated Above is Shown in Detail in the Diagram Just Below. This Apparatus Produces a Very Intense Heat and Operates with Ordinary Illuminating Gas: the Flame Point is Formed with Air from a Blower or Compressor Having a Pressure of from Eight to Ten Pounds.

THE first and most important word in the glass blower's vocabulary is Rotation. The glass must be rotated from the time it enters the flame until it starts to cool in the annealing soot. And its proper rotation can only be accomplished by knowing and working the following system.

Glass work requires little apparatus. Success depends on your personal knowledge and dexterity, and that dexterity you can acquire as the conjuror acquires his deftness—by practise. I will go into minute detail in order that you may intelligently set about building up your technique.

By rotating the work in the flame you succeed in evenly heating the whole circumference of the tube at the spot where you propose to operate. This is essential because gravity is constantly exerting a pull on the tube, and as it softens under the effect of rising temperature, it falls out of shape, lengthens and gets thin. Constant rotation overcomes gravity's effort, and you must bear in mind that the work will fall out of shape the instant you allow the tube to cease its rotary movement at any time until it has set.

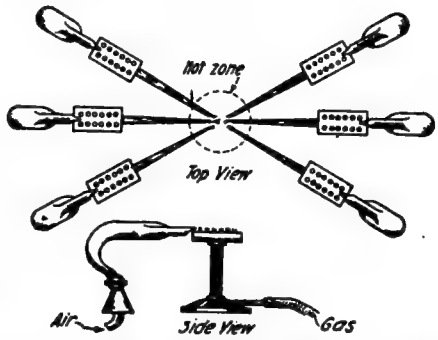
Some of your failures are now explained. You paused to blow into the tube, or to draw it out, or to push it in, and—zingo! Rotation must be continued while the tube is in the mouth, while blowing, while drawing or pushing; in fact, from the time it softens until the instant it begins to harden again. And be sure that it has started to harden.

From the foregoing you see a little of what you are up against. We may now proceed with the trick itself.

A glass tube has two ends. Both of them must be rotated at the same speed. Don't laugh. Sure, they'll have to do that as long as the tube is one tube. But when she starts to soften in the flame, you have what amounts to two tubes. And both of them must rotate at the same rate of speed.

The tube is rotated by the thumb and first finger of each hand. The remaining fingers are used to support the piece.

The position of the hands is of prime importance, and you must learn to assume



Top and Side View of Multiple Tip Gas Burner Used in Professional Glass Blowing. The Stream of Air in Each Burner Gives a Long, Thin, Bluish Flame Seen Shooting Forth from Each Burner.

that position automatically, and to keep it without mental effort on your part for periods on end, and thru many motions of the arms. As, for instance, the bringing of the open end to the lips.

The left hand takes the tube with the palm facing downward. The hand itself is slightly bent at the wrist, so that it points downward on a slant. The second, third and little fingers are curled in under the tube, it being held between them and the palm. The exact amount of grip is such that the tube is loose enough to be turned freely between the thumb and first finger. And yet it must be held firmly enough that all the weight is borne by this support, in order that the thumb and first finger will have nothing to do but to turn the tube over and over. The supporting fingers must be so bent and the hand so turned that the thumb and first finger can be extended to practically their full length, in which position they can do their work with the least fatigue.

Now the right hand is held with the palm turned toward the left, second, third and little fingers slightly bent. The tube is grasped between the first finger and the thumb. See Fig. 1-A. It is allowed to rest somewhat on the side of the second finger. Its main support and rest, however, is the portion of the hand between the first finger's base and the thumb.

The first finger, and the thumb, of course, do the rotating work. As with the left hand, they are to be extended as nearly their full length as possible.

So much for position. Now a word as to the movement. Rotation is carried on in one direction continuously, and not by a series of reversals. Keep the tube whirling in the one direction, which will most naturally be away from you.

The tendency will be to cause the tube to turn about half a revolution with each twist of the turning digits, and this must be fought against. You must build up a rhythmic series of light touches, each one of which moves the tube a little bit, and which are to follow one another just as rapidly as is possible while retaining the rhythm. You will find that you can do better work with this system with the tube at slow speed than you can with big twists and higher speed.

A few words of advice on the method of applying the above. Devote so much time—say an hour each day regularly—each day as a practise period for as long a time as proves necessary. This will vary with the individual. All the impedimenta you will need will be a length of tubing of any convenient diameter. Use no flame, but bend your effort to acquiring a smooth and steady movement.

When you are able to do this perfectly at a fair speed, take a Bunsen burner, but do not light it. Place the work over this, and endeavor to keep the tube moving in an imaginary flame, taking care that its height does not vary, nor its movement to right or left.

Being proficient in this, you may attempt what will probably prove your most difficult maneuver, but one which you simply must master. Heat your glass in this imaginary gas flame, and without

The Accompanying Illustration Shows One of the Hardest Things to Accomplish in Glass Blowing, that of Properly and Continuously Rotating the Tube When Being Heated in the Flame. This Motion Should be Practised Without a Flame Until it is Made Perfect.

ILLUSTRATING POSITION FOR HOLDING TUBING

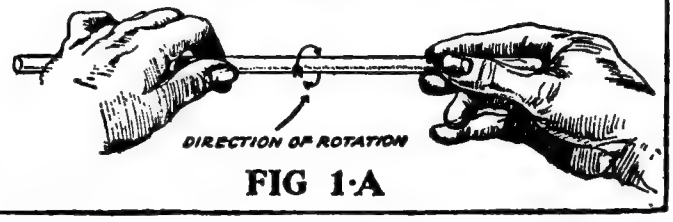


FIG 1-A

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ceasing the rotation—or varying the rate—remove from over the burner, let the left arm fall, raise the right, and bring the tube's right-hand end to the lips. Don't stop the movement. Blow in the tube. Remove it, twirling all the while. Bring it back to the flame several times, and repeat.

When you can conscientiously say that you are proficient in this little stunt, you are on your road to success.

Light your burner, and resume your efforts where you gave them over in disgust before. And—warning—even now do not expect to succeed all at once. It is true that you are master of the really difficult part of your job, but you have still to acquire several other bits of knowledge—not dexterity—among which we may mention the type of flame to employ and the ability to judge ocularly the condition of the glass and the precise blowing instant.

Let us consider now a few experiments in actual glass blowing.

A Glass Cigarette Holder

At the conclusion of this trick you may present your friend with the article. It will be highly appreciated, rest assured.

Select a piece of tubing,* outside diameter one quarter of an inch. Now the exact diameter of the tube doesn't matter a bit, so long as it is somewhere near the above. It should have a moderately thick wall.

Begin by sealing one end of your tube. You have your choice of two methods for doing this, both quite easy. Holding the tube at both its ends, bring the flame to bear on a spot near one end, for economy's sake as near the end as possible without burning your fingers. Rotate your tube, and as it softens, draw it apart, discarding the little piece as scrap.

The end is thus sealed. You will find that by carefully watching the glass in the flame you will be able to engineer things so as to leave the least possible point on the end you want to work with. As you start to pull, lift the tube free from the heat, pulling gently. The idea is not to pull it apart, but merely to start to. Put it back into the flame, heating only a very narrow spot, and let it burn apart. Your tube should now be about six or eight inches long.

Rotate the tube with one hand in the flame and bring it to a blowing heat. By gentle blowing round off the closed end nicely.

*Be sure to select or procure "new," good quality glass tubing; old tubing is difficult to work with, as pointed out in the articles on glass blowing by Professor Metcalf, which appeared in this journal several years ago.

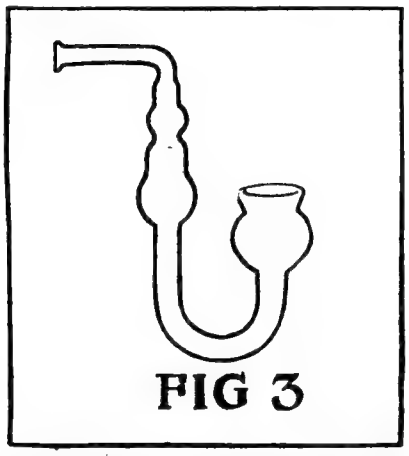

FIG 3

As You Acquire a Greater Degree of Skill in Glass Blowing, You will Undoubtedly Like to Attempt the Blowing of a Glass Pipe Like that Shown Above. Some of These Pipes are Wonderful Works of Art, Being Formed with Numerous Loops and Turns Along the Stem.

The next step is really easier to execute than to describe. The idea is to blow an egg-shaped bulb on the sealed end of the tube. To do this you must get the spot farthest away from the end the hottest, so that when you blow it takes this shape rather than a spherical one. A little practise will make this easy enough. It may be well to point out that rotation must be maintained constantly, even while blowing, and that probably in spite of your best efforts the tube will fall out of line alarmingly. Don't worry about that. You have only to cease rotation for an instant with the tube at the mouth, and gravity will bring it back to shape for you. As soon as it lines up, begin rotation and blowing.

When you have the desired shape of bulb, devote your attention to the narrow front end of the bulb, allowing the back part to become too cool to blow. Make the front end very hot, and blow quickly and with force. This will send out a bulb of comparatively enormous size, and about as filmy as soap bubble, which it greatly resembles. Probably it will burst. On first performing this operation the flaring bulb and attending snap are likely to startle you, but there is no danger.

To resume. Bring the film into the flame. It will burn off or shrink, leaving you with a bulb that resembles somewhat the bulb of a thistle funnel. Now watch your step a bit. Keep the bulb itself back from the flame, bringing to working heat only the edge just dealt with. Rotate it constantly with one hand, the left, warming at the same time the metal handle end or tang of an old file, held in the right. Dab the hot file handle end or tang on a piece of wax, draw the work from the flame—whirling—and insert on an angle the file tang. The softened glass

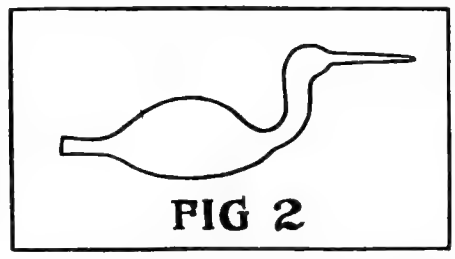

FIG 2

Another Simple Novelty in Glass Blowing—a Miniature Glass Duck. By Nipping off the End of His Bill, and Filling the Duck with Water, a Lot of Fun Can be Had by Blowing on the Larger Opening, Which Will Cause a Fine Stream of Water to Shoot Out Thru the Duck's Bill.

on the edge will press down into that neat flange seen on test tubes, if properly done. The figure will give you the idea of holding things at the proper angle.

Anneal your work by smoking it thoroly and lay on an asbestos mat to cool. When cool, finish by directing at intervals along the tube a fine flame, allowing the glass to become only perceptibly soft, the stage when it pulls quite sluggishly. Draw the ornamental constrictions shown in the drawing, suiting your fancy as to the number of them employed.

It remains only to cut with the glass knife, or file to the desired length of holder, and to flange slightly the mouthpiece end as you did the bulb.

If you feel up to it, you might next attempt

A Glass Duck

This is a piece which must be tried to be appreciated. See Fig. 2. When you can execute it smoothly, you may safely say that you are acquiring technique. Select a piece of tubing of the same stuff you used for the holder. Twelve to fourteen inches will be convenient length. Seal an end as before.

Your point of attack this trip will be about the middle of the tube, and this fact introduces complications. You must rotate with both hands, which means that at first one hand will get out of step with the other, so to speak, and twist the softened tube hopelessly out of shape. I can't help you out much here. All I can say is that it is a cinch once you have

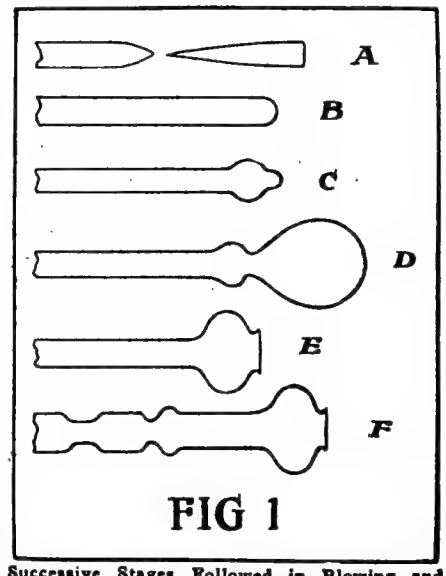

FIG 1

Successive Stages Followed in Blowing and Forming Glass "Cigar Holder" from a Piece of Glass Tubing.

acquired the knack, and that you can secure this knack by trying and failing and trying again.

Now to our muttons. We have first to blow a bulb of the shape indicated in the drawing. By intelligently directing the flame, we heat the top side a trifle more than the under, and accomplish our object.

Having annealed, and cooled, we make the simple bend that forms the neck, blow the little bulb that is the head, and draw the tubing out a bit at the bill.

This pleasing little specialty is usually cut off to allow a bit of the tube to project at the tail, and by filling the bulb with water and inserting the tail tube in the mouth we are armed with an excellent weapon for squirting water into the faces of good-natured friends. Be quite sure that the friend is good natured, tho.

Let *your pièce de résistance* be

A Glass Pipe

This requires no description, its constructional features being gleaned from the drawing, Fig. 3, and the methods employed the same as in the previous crimes.

Other little novelties will doubtless suggest themselves to individuals, and much pleasure will be derived from working them out.

Have a regular program for visitors and your fame will spread.

What has been said in this article is designed to lead to quick results and enable the interested reader to produce real results with little practice. But to become an accomplisht glass blower is no trifling thing. Some people never acquire the art. One great trouble is that the tubing will draw out and get thin when heated. If too much time is taken for an operation, the glass will become opaque and is said to crystallize. If the glass contains lead, the action of the reducing flame will turn it almost black. Finally look out for your fingers, altho you can hold a glass tube within an inch or even less of the place where it is being heated, without feeling the temperature in any way, a tube hot enough to burn and burn badly, may show no indications of heat. So be careful about picking up any tubes from the work-bench.

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HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

Making Radium Photos

FIRST PRIZE, $5.00

The photograph shown at Fig. 1 is not a South African "whatisit," but an X-ray picture of a design laid out in barium sulfate. The design was first drawn on an envelope holding the X-ray plate, and then the barium sulfate was sprinkled on it. The barium salt being opaque, it cut off the rays.

The illustration shown at Fig. 2 is another fragrant fake. This was made with the aid of a small spinthariscope, costing $1.00. This design was cut of heavy lead foil and pasted on the outside of an envelope holding an ordinary photographic plate. Enough circles were drawn on the pattern and numbered consecutively to take in the complete pattern.

Then the spinthariscope was put on the first circle for two days and moved to the next, and so on until the whole pattern was covered.

By looking closely you can see where the rays from the radium in the spinthariscope have penetrated to a small extent, even the lead foil.

This experiment was about fifty days in the making,—and neither picture was retouched.

Contributed by V. G. CLEMENTS.

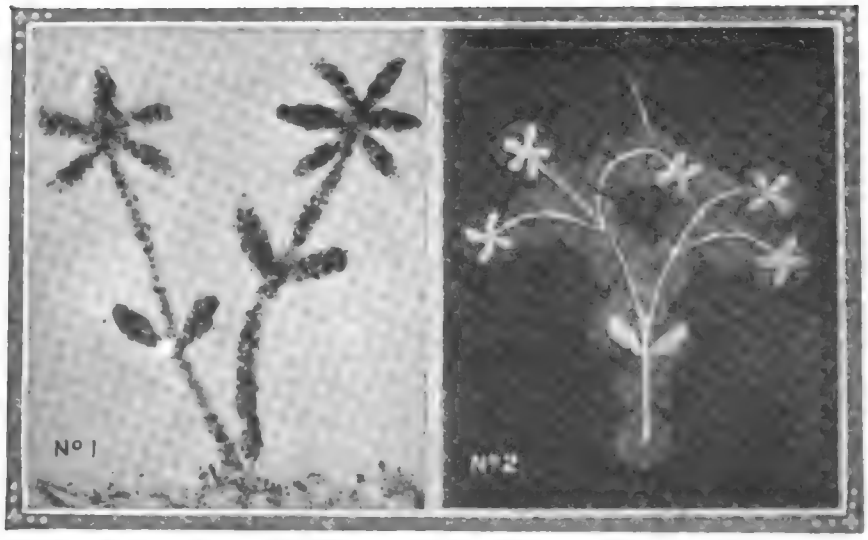


Fig. 1 Above Shows a Mysterious Photo Made with Barium Sulfate. The Mottled Effect Is Due to the Difficulty in Sprinkling the Barium Salt Evenly.

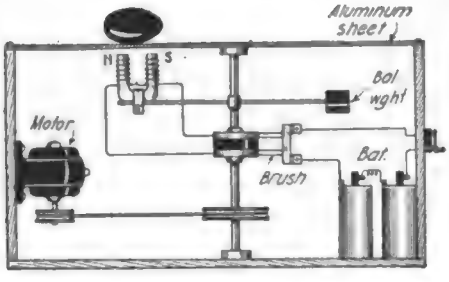
This Radium Photo Was Produced by the Aid of a $1.00 "Spinthariscope." The Design Was Cut from Lead Foil and Pasted on the Outside of an Envelope Containing a Sensitized Plate.

"The Mysterious Egg"

SECOND PRIZE, $3.00

Take a good (or bad) egg and punch two small holes in it. Then blow out all of the inside. Next fill the egg with iron filings. Then get a fair sized wooden box and saw a round hole in it large enough to accommodate an aluminum or brass pan. Procure an electro-magnet and a small motor (electric or water) and put the magnet on one side of a rotatable wooden bar. The motor turns the magnets round and round and as the batteries connect to the magnet it will draw the egg around also.

Some time ago there was described in the columns of Science & Invention a similar device provided with two permanent steel magnets, which were caused to pull two painted iron bugs over a thin aluminum plate, on which a clock dial was painted. The mechanism was arranged with clockwork, so that the outer bug indicated the minutes, and the inner bug the hours.



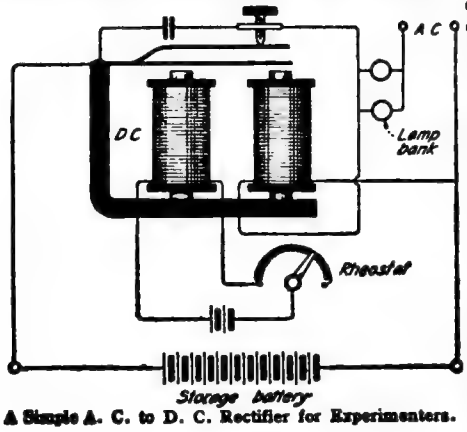
The Motor Rotates the Electro-Magnet Mounted on the End of an Arm in the Manner Shown, and the Iron Filled Egg Is Pulled Around Over the Aluminum Sheet by the Rotating Magnet.

Contributed by LUCIUS M. TURNER.

A Simple Vibrating Rectifier

THIRD PRIZE, $2.00

Some time ago I had occasion to use a small rectifier for charging small storage batteries and "building up" several six volt batteries. In view of the fact that other experimenters may at some time or other need something like the above mentioned rectifier, I am describing it herewith.



A Simple A. C. to D. C. Rectifier for Experimenters.

On a rather heavy bell, separate the connections between the two electro-magnets, so as to give two separate, individual units. Connect a condenser across the vibrator arm and the adjusting screw. A condenser of about one-half M. F. will answer the purpose. A rheostat is now connected into the circuit as shown in the diagram, and the other connections are made as indicated.

The operation is as follows: Owing to the action of the direct current in the D. C. magnet, one end of the armature A, will be permanently of north polarity; and since the A. C. magnet will alternate with the alternations of the current, the armature will vibrate in step with the A. C. input. This allows for contact, in such a way that a pulsating direct current will be obtained. Adjustment for the D. C. magnet is made by the rheostat, which should allow this magnet to have approximately the same strength as the A. C. magnet.

Contributed by A. H. MATHEWS.

PRESERVING SLICED SWISS CHEESE.

Swiss cheese when sliced, is ordinarily difficult to preserve fresh and moist. As commonly kept by housewives, it rapidly dries out, becomes hard, curls and turns a deep yellow. Placing it in the refrigerator fails to overcome this process of deterioration. The one provedly effective method of preserving its original freshness, etc., is to keep the slices constantly wrapped in a damp sheet of white linen, except during actual eating-time.

Contributed by C. NYE.

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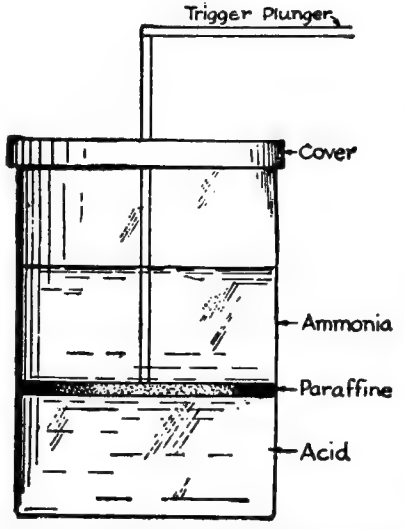
Interesting Chemical Experiments

By O. IVAN LEE, B. Sc.

"Fireless" Smoke

THE old proverb "Where there's smoke, there's fire" is far from being a reliable one, because to the chemist smoke without fire is a not infrequent occurrence. To those not so familiar with chemical facts, the appearance of rolling clouds of white smoke without any vestige of flame or heat is always a bit perplexing and savors of the mysterious. But first, let us take a moment to consider what smoke is. It may be looked upon simply as a multitude of very small particles of solid matter suspended *temporarily* in a gas, usually air. There is no such thing as permanent smoke. You can't put it in a bottle and keep it, for sooner or later the solid matter will settle out from the air which supports it. For similar reasons, it is impossible to have smoke in a vacuum such as exists in an electric light bulb, for since there is nothing in a vacuum, the particles of which the smoke is composed would fall down instantly. Of course there are a few colored gases, such as the deadly greenish yellow chlorine which the Germans let the wind blow over the defenseless Canadians in Flanders, but it is not correct to refer to such colored gas-clouds as smoke.

Any chemical action, then, which will form a solid substance floating in air will give the effect of smoke. Naturally, this condition can best be brought about if the two chemicals which are to combine or react are themselves (invisible) gases. Ammonia is one such a gas. Ordinary ammonia is a solution of this gas in water. When the ammonia water is heated or even exposed to the air, the invisible ammonia gas goes out of the water into the air and makes its presence known by its piercing smell. Since ammonia is an alkali, it will easily combine with an acid to make a solid salt. It is only necessary, then, to make smoke, to find an acid which is also a gas. Fortunately there are two that are easily obtained.



With This Simple Apparatus Great Clouds of White Smoke Can Be Produced. It Makes a Very Striking and Mysterious Experiment

On a clay saucer such as is used for flower pots place some pieces of sulfur or some flowers of sulfur and set it burning. It will burn with a pale blue flame and choking but invisible fumes. These fumes are sulfurous (not sulfuric) acid. Now place the saucer on a little block of wood placed in the middle of a plate or pie-tin and pour some strong ammonia water around it, in the plate. Instantly white clouds of smoke will arise around the saucer until the whole resembles a smoldering pile of leaves. To show that it is the fumes of the sulfur and not the flame that is necessary to make smoke, repeat the experiment, but first extinguish the burning sulfur with a piece of asbestos followed immediately by pouring in the ammonia as before. The same white smoke will be produced, altho now there is no flame. The effect can be made much greater by placing some muriatic acid in a saucer instead of using the fumes from sulfur. This acid is much stronger than sulfurous acid, and its fumes with ammonia are very dense, white and voluminous.

After you have thus become familiar with smoke, ammonia and muriatic acid, you can startle your friends with the following experiment:

Place a thin glass tumbler on a table and pour in about half an inch of muriatic acid without pouring it down the side of the glass, and without spattering any inside. It is not difficult if you pour smoothly from the acid bottle without letting the acid gurgle as it comes out. Now melt some paraffin wax (not too hot) and pour it down the side of the glass very carefully until there is a layer about an eighth of an inch thick floating on the acid. When the wax gets hard it will seal the acid underneath completely. Blow out any acid fumes which may still be in the glass above the wax and then pour in about an inch of strong ammonia water. Over the top of the glass, place a tin baking powder cover with a hole in it about an inch in diameter. Nail a short round stick about eight inches long and half an inch in diameter perpendicular to the end of a flat stick about a yard long and an inch wide. When your audience is gathered, carefully insert the end of the round short stick thru the hole in the tin cover over the glass, and using the long stick for a handle, give the end of the short stick a quick push downwards against the wax. There will be no flash and no noise, but a huge cloud of dense white smoke will puff up like a "jack-in-the-box" and you and your friends will experience all the thrill of seeing an explosion close by, with the disagreeable features eliminated.

Synthetic Perfume of Lilac

By GLENN SLOVER

THE preparation may be divided into two operations (a) the transformation of common oil of turpentine into terpin(b) the transformation of terpin into terpinol.

To prepare terpin put one pint of oil of turpentine in a quart bottle. Three-fourths of a pint of alcohol 80 per cent is mixed with it, and one-fourth pint of nitric acid is slowly added to the mixture, which is left several days, until crystals are formed. These are collected and dried with blotting paper. To get the full amount formed, one should wait over three months; but, for experimental purposes, such a delay is unnecessary.

To transform odorless terpin into fragrant terpinol, set up an ordinary distilling apparatus consisting of a one-pint flask, delivery tube and condenser. Fill the flask half full of water. Put two or three spoonfulls of terpin in and the same amount of sulfuric acid.

As soon as the liquid boils, a delightful scent fills the room. Distil until no more terpinol passes over. If any water has distilled over, a layer of liquid terpinol will be found on top of the water and can be easily removed. The fragrance is extremely strong, while the essence is warm, it becomes much more agreeable after it has cooled. Some odoriferous plants, such as marjoram, contain terpinol in their leaves, but the extraction of the essence from such sources is always much more expensive than its synthesis with oil of turpentine.

AN EXPERIMENT IN INSTANTANEOUS CRYSTALIZATION.

Dissolve sodium hyposulphite in 15 cc. of water to saturation, by heating, and pour the solution slowly into a clyinder which has been warmed in boiling water, filling the same about one-half full of this solution. In another beaker dissolve sodium acetate also to saturation in 15 cc. water, heat gently till all is dissolved. Pour this solution slowly on top of the first in such a way that it forms an upper layer, without mixing the solutions. The two solutions are then covered with a thin layer of boiling water and allowed to cool.

Lower into the cylinder a wire, at the end of which is fixed a small crystal of sodium hyposulphite. The crystal traverses the solution of sodium acetate without causing trouble, but crystalization immediately takes place as soon as it touches the hyposulphite solution.

When the hyposulphite solution becomes crystalized, lower in the upper solution of sodium acetate, a small crystal of the acetate suspended by another wire, and this will crystalize immediatcly as did the hyposulphite solution.

Contributed by H. J. RUNDT.

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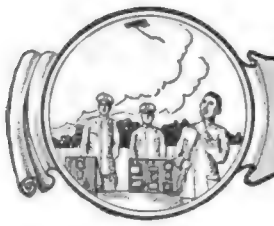
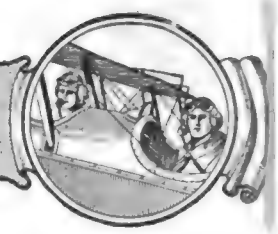


RADIO DEPARTMENT



Chicago Police Use Radiophone

A SHORT time ago a new scheme for organizing the police systems of the larger cities was inaugurated in New York City, with the demonstration of the advantages of inter-city radio-telephone and telegraph. Now we learn that the city of Chicago has arranged to install an elaborate radio system to aid its police department in their war on crime.

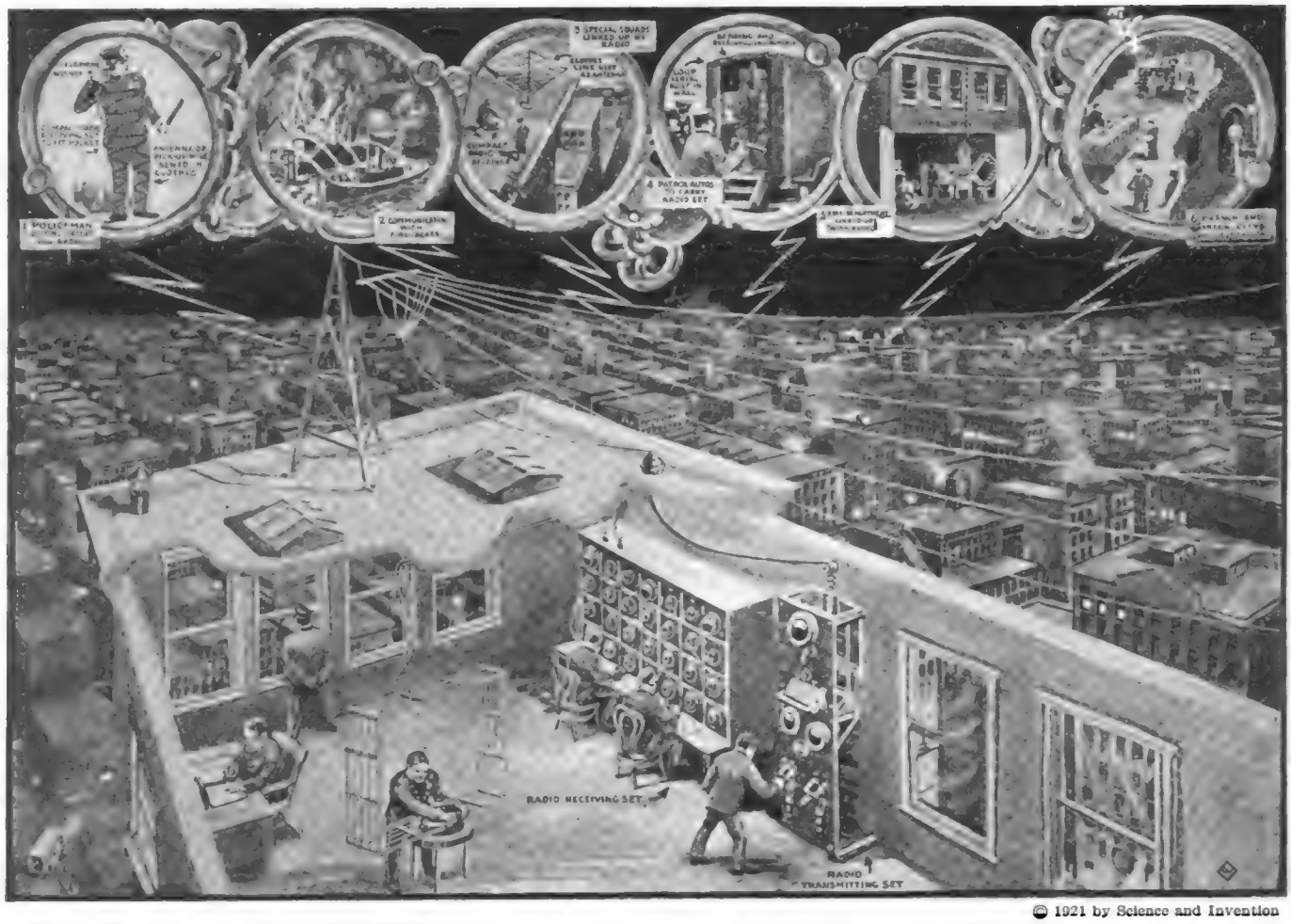
A $12,000 radio plant of the very latest type has been installed on the roof of the Chicago City Hall for constant wireless communication with rifle squads, fire boats, fire engine houses, police stations and patrol wagons. At first the terminals of the police radio system will be equipt with apparatus only for the reception of radio messages.

Mr. William G. Keith, Commissioner of Gas and Electricity for Chicago, and who proposed the adoption of radio in this manner to aid the police department in their work, said that he hoped ultimately to have every policeman equipt with a compact receiving apparatus, weighing but a few ounces and capable of being concealed under his clothing.

The accompanying illustration shows how wonderfully a radio system can extend and speed up the activities of a police and detective organization. Suppose for example, that a rifle or other squad of police or detectives are greatly outnumbered in an encounter with thieves, or that they are badly cornered, with the chance of being annihilated; they can, with a good police radio system in operation, set up a small pocket wireless set and flash *headquarters* for help. Not only this but with a portable and compact transmitting and receiving set such as is available today, employing a wire clothes line or else some insulated wire spread out on a roof or hung over the edge of a building, news of the movements of the outlaw bands can be instantly communicated to Headquarters; or again, from Headquarters to the local squads who may be engaged in the man hunt.

Patrol autos can easily be fitted up with an efficient radio transmitting and receiving set of small size, thanks to the present highly perfected vacuum tube amplifiers and undampt wave generators employing such tubes—thus providing the police with a scientific improvement which should be of inestimable service in many instances, especially in case of riots, racial fights, strikes, etc.

The Fire Department of such a city as Chicago will undoubtedly find the radio system a great aid in their work, especially when used in conjunction with the police system, as for example, when extra police reserves are needed to keep the curious crowds back and away from buildings liable to fall, etc.


3 SPECIAL SQUADS LINKED UP BY RADIO
4 PATROL AUTOS TO CARRY RADIO SET
2 COMMUNICATION
RADIO RECEIVING SET
RADIO TRANSMITTING SET

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The City of Chicago Has a Very Progressive and Wide Awake Police Department, and There Has Recently Been Installed a $12,000 Radio Plant of the Very Latest Type, on the Roof of the Chicago City Hall. This Will Be Used for the Purpose of Keeping the Police Department in Constant Wireless Communication With Rifle Squads, Fire Boats, Fire Engine Houses, Police Stations and Patrol Wagons

A Few July "Radio News" Features

The Lyon Radio Station.
By the Paris Correspondent.
Experimental Measurements and Calculations. By P. F. Geagan
Throw That "B" Battery Away.
By Charles L. Whitney
How to Construct a Heavy Current Transmitter for Radio Work.
By H. Marple
Radiating Eight-Tenths of an Ampere With a Single J Tube. By A. H. Lynch

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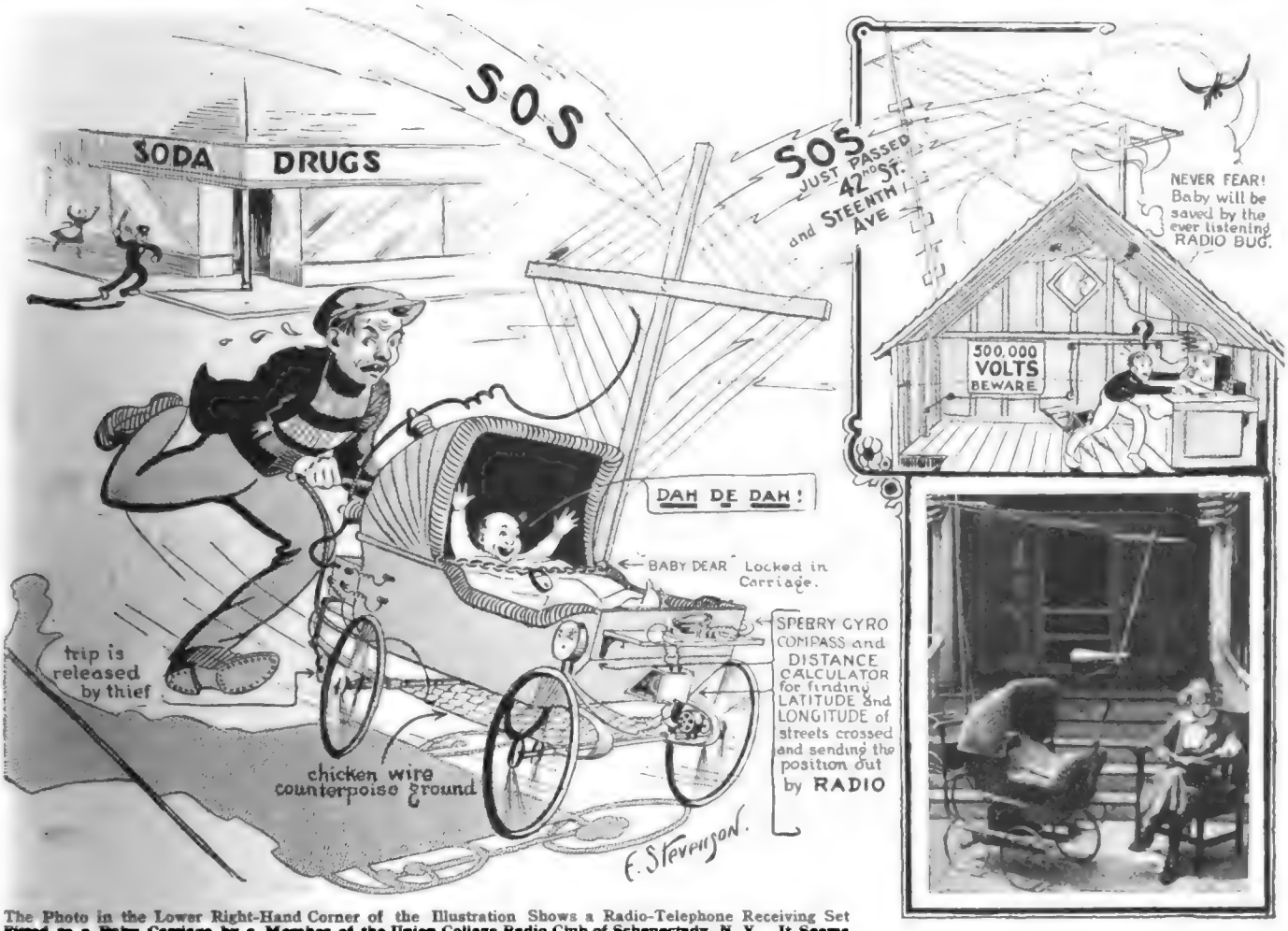
The Radio Lullaby Is Here

Well, well, we never would have thunk it, but the world is advancing and we will be dingbusted if here isn't the wireless baby carriage. This glorified baby pullman, which was invented by a member of the Union College Radio Club, at Schenectady, N. Y., has many possibilities we believe. It seems that the inventor had originally intended this wireless receiving outfit for baby carriages, for the purpose of picking up and amplifying wireless telephone music sent out by a station at his club, or by amateur radio stations in nearby territory, so that whenever the kid who happened to be the lucky possessor of such an outfit, started to cry and cut up the music would soothe him. All nursey has to do is to throw the switch and bingo, out pours the wireless music which will lull the irritant child into deep slumber —perhaps? We presume that if said youngster is of German origin, nursey should parade him in the vicinity of German amateur radio stations, so that he can be lulled to sleep by the music he really loves, such as "What is Kaiser Bill Doing Now" and "Everybody Works but Bill"; if Turkish, then Turkish stations should be cultivated; if French, then French amateur stations, etc., etc.

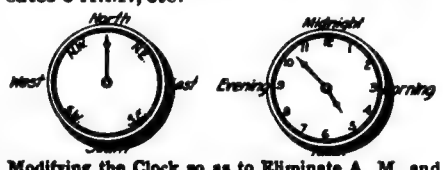
As our able accomplice in editorial criminology, the artist, has shown with his trusty pen, there are many other wonderful possibilities opened to the wireless equipt perambulator—chief of which, perhaps, might be mentioned its utility in preventing kidnapping. By a simple attachment, as shown in the drawing, the radio apparatus on the carriage can be connected by means of a mechanical trigger device to one of the wheels, so that if a thief should start pushing the carriage once nursey had set the device, the radio apparatus would instantly be set in operation. Then, by means of the Sperry range predictor, a couple of gyro compasses and a few other dew-jabs, including an omnigraph, the whereabouts of little Tweetums will be found by the trusty radio amateur who is always waiting in the offing, ready to become a hero at a moment's notice—for thanks to this radio device it will become possible to flash out the longitude and latitude and perhaps even the names of the streets, as the thief and the baby dash wildly down the avenue. Of course little Tweetums was carefully locked in with a couple of chains and half a dozen Yale locks, so that the thief could not lift him out and thus foil the brainy inventor of this most remarkable radio invention since the great Signor Marconi flashed his immortal three dots across the briny.


S.O.S.
SODA
DRUGS
S.O.S.
JUST PASSED 42nd ST. and STEENTH AVE
NEVER FEAR! Baby will be saved by the ever listening RADIO BUG.
500,000 VOLTS BEWARE
DAH DE DAH!
BABY DEAR Locked in Carriage.
trip is released by thief
SPERRY GYRO COMPASS and DISTANCE CALCULATOR for finding LATITUDE and LONGITUDE of streets crossed and sending the position out by RADIO
chicken wire counterpoise ground
F. Stevenson.

The Photo in the Lower Right-Hand Corner of the Illustration Shows a Radio-Telephone Receiving Set Fitted to a Baby Carriage by a Member of the Union College Radio Club of Schenectady, N. Y. It Seems that the Prime Object in View by the Inventor was to Provide a Radio Pick-up System for Supplying Baby with Lullaby Music as Sent Out from the Radio Club or Nearby Amateur Wireless Stations. We Suggest, as Shown in the Illustration, that the Radio Baby Carriage Outfit be Developed a Step Further by This Genius, so that when the Bad Man Tries to Steal "Snooky Ookums" the Whole Contraption Will Function so as to Send Out S. O. S. and Position Calls, via Radio, Such as "Come Quick, I Am Being Kidnapt. Just Past 42nd St. and Steenth Avenue," etc.

Anti A. M. and P. M. Clocks

In Italy the day is divided into twenty-four consecutive hours so that a train leaving at 13 o'clock, leaves at what we would call 1 o'clock in the afternoon. We illustrate a dial which our correspondent proposes to introduce for use on clocks. By weighting the balance wheel or otherwise modifying the construction, he proposes to reduce the speed of the movement to one-half its present rate, so that the hour hand will take 24 hours to make its circuit. In this way, each hour will count for two. If a person wants to get up at 6 o'clock in the morning, it will be according to this clock, 3 o'clock, and noontime will be 6 o'clock. He draws an analogy between it and the compass which we also show in diagram where the north point, indicates midnight, northeast indicates three A.M., east indicates 6 A.M., etc.



Modifying the Clock so as to Eliminate A. M. and P. M., the Hour Hand Revolving Once in 24 hours.

It is perfectly logical so to construct clocks that the hour hand could go around once for each 24 hours. How we fell into the habit of splitting the day in two and making our clocks according to this division is not clear, and we presume that any attempt to rectify the confusion incidental thereto, is to be welcomed. There are few of us, who in our use of railroad trains, have not at one time or another, confused the A.M. time with the P.M. time.

This clock, conceived by Edmund R. Deering, a patent for which has been applied for, would obviate any such danger

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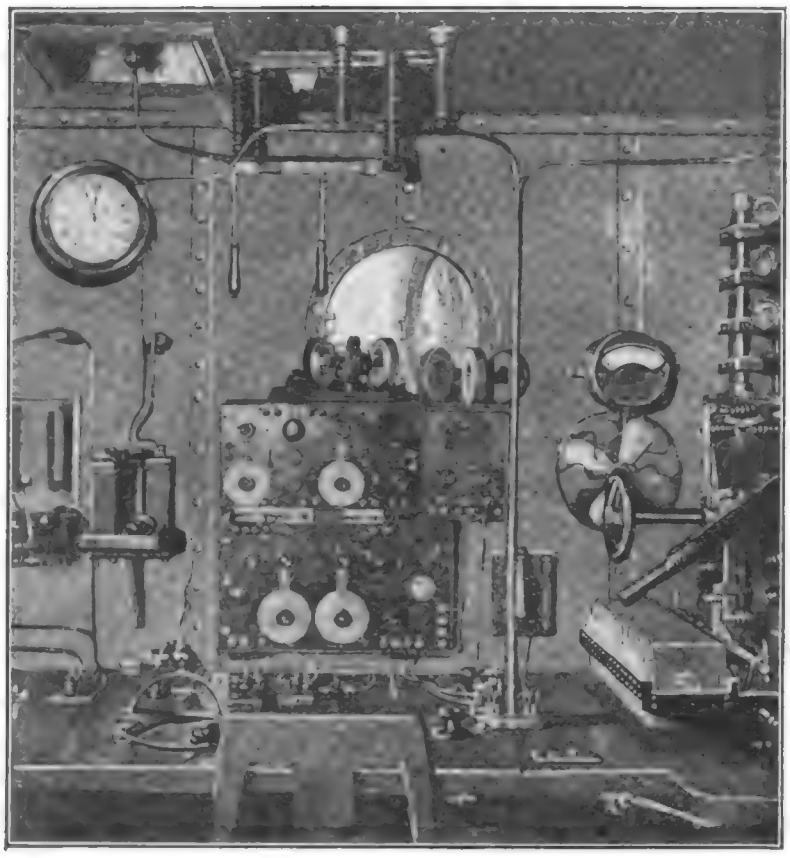
Working Two Radio Watches at the Same Time

By ARTHUR H. LYNCH

CONTINUOUS wave telegraphy is unquestionably here for good and there is a very natural contention on the part of some that the spark system is doomed, if not to a speedy, at least to an eventual demise. However, there are certain uses to which spark transmission may be applied which cannot be duplicated by C.W. and it may be well to stop here a moment and ponder.



Typical Ship Radio Receiving Set Adapted to Be Used With the Dual "Arc and Spark" Switching Scheme Here Described.

For trans-ocean, which, nowadays might better be termed "international," radio-communication, we find that the interchange of thought is effected almost entirely by one form or another of continuous wave transmitter.

Then we daily are brought to the realization that C.W. is rapidly gaining a very significant position in the merchant marine. It will be remembered that it has long held such a position in the communication service of the U. S. Navy. Arc and tube transmitters are rapidly being installed and in some cases are actually supplanting the spark sets on some American vessels. This tendency toward arc transmission is most apparent in vessels under control of the Shipping Board, which, in a great measure is responsible for the interest which has lately been stimulated in this type of apparatus, due to some very remarkable results having been obtained.

Vast Difference in Operating

The methods used for the most satisfactory reception of C.W. cannot be satisfactorily employed for spark reception and vice versa. Of course the arc wave modulated by the chopper, and the tube wave modulated by a buzzer or other method, can be picked up on a crystal or other rectifying detector, but there is a decided loss of efficiency.

Here we find two directly opposite and equally important conditions; one favorable to C.W. and the other favorable to spark transmission. Let us first consider the C.W. For strictly communication purposes it is preferable to spark, even tho it is not capable of equal range—speaking of modulated C. W. and spark of equal power ratings—because the emitted wave is very much sharper and does not cause interference such as is experienced when spark is used. When like power is supplied to a C.W. transmitter and reception is carried on with a receiving equipment, designed on the heterodyne or autodyne principle, the range is found to be very much greater for the continuous waves. The tuning is similarly very sharp.

And study of the existing methods for the production of radio waves by the spark method brings us to a consideration of the system generally conceded to be the most efficient, namely, the quenched-gap. Here we find a system which is still well within the law, but which can be made to produce a very broad wave if it is desired. Where we have a combination transmitter, where both the quenched and rotary gaps are available, such as is the case with the Navy Standard sets placed on many merchant marine vessels while under Navy control, the use of the rotary permits even a broader wave.

There are two conclusions to be drawn from these operating characteristics and they are that the C.W. is unquestionably the more suitable for ordinary communication, because there is much less possibility of "jamming," and the spark is much more suitable for distress work, where it is desired to send as few signals as possible and have them reach as many stations as are in range *simultaneously*. In such instances the more interference the vessel in distress can produce, the better are her possibilities of securing aid before her radio is rendered useless from one cause or another.

Where communication is carried on by the C.W. method, a very close watch must be maintained, if all calls are to be heard and vessels must be very accurately tuned, especially as regards their calling wave. In order to aid the arc stations in communicating with one another the Federal System has placed a variometer in series with the antenna, so that the operator may slightly vary his emitted wave while transmitting, so as to be heard at the station of destination, if the two stations are not in perfect resonance.

Another consideration is the radio beacon. During thick weather a conventional signal from a station of this character is used to guide vessels on their otherwise blind ways, and is used in conjunction with the radio compass, designed especially for shipboard use. The radio beacon station is the direct reverse in action of the radio compass stations, now in use at many places along our coast line. Would it be more advisable to have these beacon stations transmit undampt or moderately dampt waves? There are some very good arguments on both sides of this question, but the author is of the opinion that this is one place where the spark will always hold its own.

In our endeavor to perfect our communication systems, it is undoubtedly worth our while to remember that, tho radio is a very potent aid to our national expansion from a commercial and economic standpoint, the strongest reason for it being adopted is the *safety factor* it affords. There are many ships now carrying radio apparatus for the sole reason that it is required by law, even in the face of the many instances which have proven very definitely that it is more a question of "Can our vessel afford to be without it?" than "Can we afford it?"

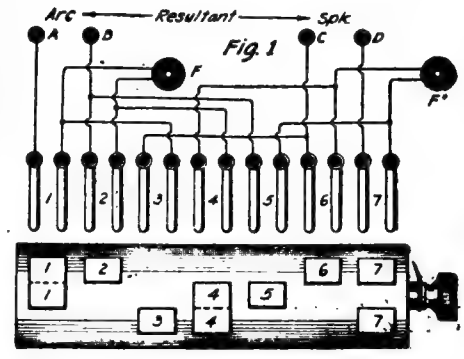


Fig. 1

Fig. 2

Hook-up of Dual "Arc and Spark" Receiving Switch of the Drum Type.

(*Continued on page* 280)

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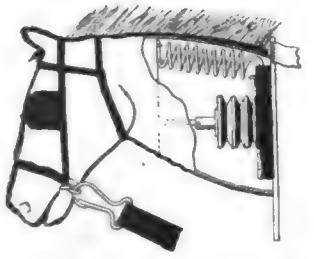
LATEST PATENTS.

Toy and Physical Culture Apparatus

(No. 1,372,351. Issued to Amy L. Hurlstone-Jones)

This is a very ingenious device; it will give a child plenty of fun and at



the same time will develop muscles. It consists of an animal's head, carried on a flexible neck, containing one or more springs, and secured to a board, or leather or other suitable material, and provided with straps so that it can be fastened to the back of a chair, the foothold of a perambulator or even to another child. By tugging at the reins the animal's head will move, dependent upon the pull and it may be so arranged, that the horse's head will give forth a neigh resembling that of the animal. In the modified construction the head may be mounted directly upon a nursery hobby-horse.

Boat Race Game

(No. 1,373,679. Issued to Charles E. Silkworth and Amos P. Silkworth)

This is a very interesting game, whereby a boat race is featured and the winner of course gets the prize.

There is a circular platform upon which are mounted boats suitably pivoted to allow them to keel over imitating the regular vessels. A marker boat for the starting and the stopping position indicates the winner. When an electric fan is turned on the boats race round the course due to the action of the fan which causes air currents sufficient to rotate the platform. After a short while the current is turned off and the boats come to a rest, the vessel nearest the marker being the victor. The entire device may be mounted within a hood, and covered by a glass, so that the fan is concealed and colored lights and signals greatly enhance the effect.

Airplane

(No. 1,376,306. Issued to John Ziegler)

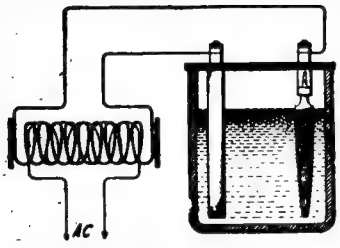
This multiplane, or combination multiplane and double bi-plane, provides for very large maintenance plane surfaces, located in spaced relation, one above the other, so that they engage the varying strata of air for sustaining the plane. It stands to reason that a plane of this type may be built very

large and of large carrying capacity. It is provided with stabilizers in connection with the opposite edges of each plane, for maintaining the equilibrium and a portion of each plane serves as an aileron. The motors are placed so as to bank the air between two different planes on two different levels.

Resharpening Files

(No. 1,372,170. Issued to Sidney Thomas Judd)

This process, for which a patent has been granted, will enable anyone to easily sharpen files and rasps. It employs a high tension electric current on a high tension circuit, the spark length of which in air is equal to the length of the file or rasp, and the duration of treatment in minutes is equal to the average length of the files in inches. The files so treated are placed in an electrolyte, consisting of a dilute sulfuric and nitric acid solution, and it makes no difference whether the files are flat, round, square or three-cornered. The files are first washed and wire-brushed in a solution of lye, so as to clean off all the grease, and are suspended from the anode, while some

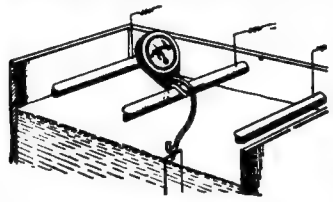


other suitable cathode is inserted into the electrolyte. The latter may be composed of three-quarters of a part of pure nitric acid and one and one-quarter part of sulfuric acid in nine parts of water. The secondary of the transformer is then adjusted so that if a 10 inch file is to be resharpened, it will give a 10 inch spark and the duration of time for treatment is 10 minutes.

Current Density Indicator

(No. 1,374,918. Issued to Edwin Heil)

In the process of electroplating it has been found that the best results have been obtained by passing a given number of amperes per unit of surface thru the cathode formed by the articles being plated. For example, in nickeling, 5 amperes per square foot of surface may be considered highly effective, but due to the irregular contours of the articles to be plated it is often difficult to properly estimate the amount of current passing thru the bath per unit of surface of the goods, even tho ammeters are connected in the circuit. The inventor of this current density indicator provides an ammeter specially calibrated and connects the same to a hook on which is suspended an electrode having

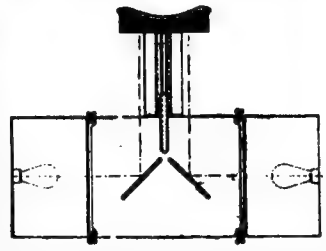


a determined unit of surface. In this manner he is able to determine immediately by direct reading the current strength per unit of surface plated.

X-Ray Stereoscope

(No. 1,373,847. Issued to Harry F. (Waite)

The usual X-ray apparatus enables physicians and others, who use X-ray plates, to obtain a reading from the plates, but in order to get a correct and adequate representation, some kind of stereoscopic effect is of importance. The stereoscopes heretofore used have been rather hard to adjust, because of the fact, that the observer must hold a certain position wherein he obtains the relief effect. In this improved form two lanterns illuminate their respective plates with an even illumination, and these plates are placed near mirrors, preferably made to stand at right angles to each other and at 45 degrees to the plates. There is a head-piece thru which the observer looks, similar to the head-piece of a household stereoscope, except that it has no lenses.

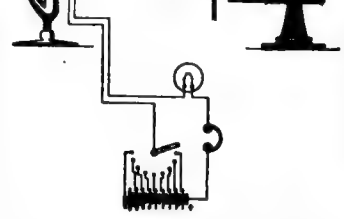


This is mounted so as to slide back and forth as desired and hold any assigned position, and a partition prevents the observer from seeing the left mirror with the right eye and conversely.

Signaling System

(No. 1,369,781. Issued to Theodore Willard Case)

Signaling by means of ultra-violet and infra-red rays had become quite an important factor in the recent world conflict. Mr. Case has here secured a patent upon such a method. The light rays, mentioned above, are ordinarily invisible, and may be projected from an incandescemt bulb or from a searchlight. If it is desired to transmit only the infra-red rays, a screen of smoked glass of sufficient thickness is placed in front of the searchlight. A shutter allows for the projection of the ray, which is focust upon a reflector, which in turn has in its focus a photo-electric



cell. In series with this is a pulsation generator, comprising a vacuum tube or bulb, or one filled with neon, argon, helium or other suitable gas. Ordinarily no battery current will flow across the two platinum electrodes in this pulsation generator, but upon action of the infra-red rays upon the photo sensitive cell, a circuit is closed, causing an audible note in the telephone receivers.

Severing Sheet Glass

(No. 1,373,533. Issued to Harry G. Slingluff)

In some of the large glass companies sheet glass is produced in one long continuous piece, but it has very often been found that the diamond or roller cutters do not answer the purpose, as well as would be desired, when it becomes necessary to sever this sheet into smaller pieces. So the inventor of the above patent has devised a very clever process and apparatus whereby glass may be cracked evenly. This consists of a pair of bars on opposite sides of the sheet which are connected together by means of U-shaped members, to the inside of which members are fixt electro-magnets. These bars are also provided upon their inner sides with

asbestos strips and upon the inner surface of said asbestos strips, resistance wires are fixt. The operation of the device is simple. Current is sent thru the windings of the electro-magnets, which causes the bars to come in close contact with the glass. Current now heats the resistance wires on both sides and also heats the glass along the line of the wire. The operation at no time is stopt, in that the apparatus moves upward at the same rate of speed as the glass, being held in the fixt position by the electro-magnets. When the certain predetermined limit is reached the current is automatically turned off, and a jet of cold air is shot toward the glass severing it evenly.

Tooth Brush

(No. 1,369,966. Issued to Arthur Cosens amd Thomas Richard Peden)

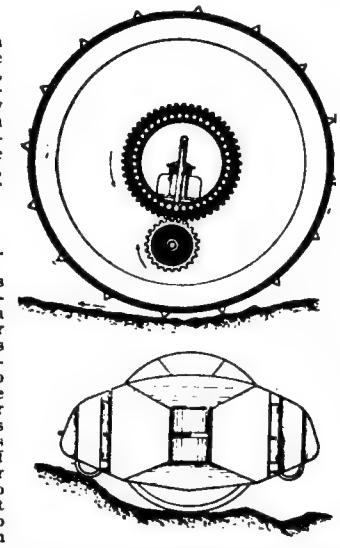
These two inventors have secured a patent upon a tooth brush, the construction of which is such, that the teeth may be effectively cleaned by alternate up and down rotary movements of the brush. The brush is formed convex or round in shape and the bristles upon the surface conform substantially to the contour of the teeth. Upon the handle an elongated ball-shaped portion is provided so that it can be gript by the fingers, which ball shaped portion may be grooved to provide for a

better grip and enable the operator to brush his teeth by rotating the bristles of the brush.

Monocycle-Vehicle

(No. 1,374,761. Issued to Carlo Pomilio)

This is a new monocycle with which one should be able to travel over open land destitute of roads, and if desired the device can be converted into a war machine. It is shaped as a large roller or hollow drum of great diameter and of a width sufficient to house the driving plant, the materials to be transported, passengers and crew along with the necessary guns, if in war-service. There are two ways of obtaining the forward movement, first by displacing a heavy center mass, causing the weight to constantly ascend and climb on an inner surface of the roller and by this displacement to produce the forward movement, or the motor is directly geared to the roller and suspended from within the drum hanging like a pendulum from a large hollow shaft. The



engine drives a couple of pinions which mesh with two toothed crown gears, provided on the cheeks of the drum. The drum itself is shaped in such a manner that its face will be curved, and when it is desired to turn a corner a heavy weight suspended on a cross bar inside is shifted, causing the vehicle to tilt over and hence execute the turn.

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What to Invent

By JAY G. HOBSON

Home Fire Extinguisher

IN every home where there is fire there is danger of fire; and where there is danger of fire there should be a dependable extinguisher of some kind. Most extinguishers offered the public today are too expensive. Most people appreciate the importance of having a means of preventing and fighting fires, and will gladly buy an extinguisher for the home and business, when someone invents one that can be sold at one dollar.

A reliable extinguisher that can be sold at a profit for one dollar, could easily be made with crude carbon-tetrachloride as the filler, which is obtainable, by the fluid-pound, from any wholesale drug company. This scientific chemical fire-killer can be prepared and packed in eight ounce bottles for an average of twenty-five cents each. Eight ounces will be sufficient to put out most fires if applied before it has gotten beyond control. Retailing same at one dollar per bottle will enable the manufacturer to sell it thru house-to-house agents, allowing them about 100% profit and still leaving a good margin for the supply house.

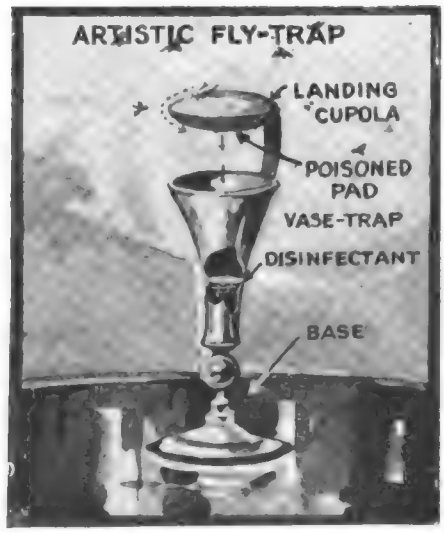
A small classified advertisement for agents to sell this extinguisher should bring considerable replies from canvassers who would gladly represent you in their respective territory. Specialty agents seldom ask for credit, and it is this cash-in-advance business that enables the manufacturer to start and successfully operate a small factory, because he can turn his capital over so quickly. There are several good agents' magazines that will connect you with live canvassers for this extinguisher proposition and for others that you may add from time to time. But just at present an economical fire extinguisher, as above described, should prove especially successful if properly handled and advertised. Carbon-tetrachloride can also be used as a *dry cleaner* of clothing with splendid results.

Improved Water-Wings

For several summers, swimmers have been using the lung-exhausting cloth water-wings, that are secured under the arms. For the beginner there is no doubt about the merit of a teacher, or rather a means for supporting the body in the aqueous substance; but the present form of buoys seem very clumsy to me. In the first place they continually lose air and in the second they interfere with the motion of the swimmer, besides failing to even the body in motion as it should do to instill the confidence necessary to make the layman self-reliant when alone.

The "Water Wings Which Youngsters and Grown-ups use Every Summer While Learning to Swim," Says Mr. Hobson, "Are Difficult to Swim With Owing to Their Size and Position When Worn." The Author Suggests an Air Chamber Made Like That Shown So That the Swimmer Has Perfect Freedom to Strike Out With the Arms.

My idea of an efficient teacher and a buoyant device will be seen in the accompanying illustration; it is constructed of a long, rubberized tube with an air injection valve for filling; it is only long enough to reach from the neck to the hips, and worn over the spine which is the center of balance in the water. Being elastic it permits bending with the body's motion. Being about three inches in diameter and as long as the torso, it will offer less resistance when swimming, and will also allow the user to swim in any position desired—*with safety*.



A Novel Idea for a Fly Trap Is Here Given by the Author. The Fly, After Eating the Poison, Falls into the Disinfectant Solution in the Bottom of the Vase

An Artistic Fly-Trap

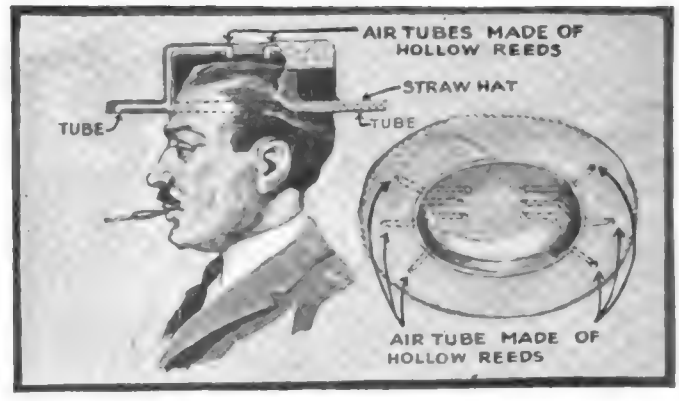
I believe an extensive market could soon be obtained for an improved fly-trap similar to the one pictured here. As will be seen, this vase-like trap has a peculiar cupola above the opening, which is intended to serve as a landing place for the flies. A poisonous substance is spread on the pad underneath the cupola. Inside the vase-trap is a liquid disinfectant. The action of the fly is as follows: He smells the sweetened arsenic (or such attractive poison as is used) lights on top of cupola, walks around surface until he finds the pad underneath; walks onto pad, eats the poison, becomes dizzy, falls into vase and is pickled in the disinfectant.

After June the first, the grass bonnet will be in evidence everywhere except at the North Pole. The customary "straw lid" looks perfectly sublime in its apparent coolness, but if my memory is correct, I recall that straws were rather warm last summer. That is, the heat from Old Sol seemed to pay no more mind to a straw hat, than it would have to one made of glass. Of course that may be a little overdrawn, but what I am trying to say is that the present construction of straws doesn't give the degree of protection from the sun it should to afford the comfort desired by all; and I believe the reason for this is the lack of air space between the two layers of woven grass which compose the body of the hat when prest into shape.

My suggestion is to conceal air tubes between the layers of straw, so there will be an air insulation, circulating there, which will also supply fresh and cool air to the head of the wearer. If the proper material is used, the weight and size of the hats should be little, if any, greater than that of the present kind. Anything to provide more comfort without sacrificing too much style—the balance of the scheme I will leave to the manufacturers.

(Copyright 1921 by the author)

Ever See a Cool Straw Hat? No! The Author Suggests That Small Air Tubes Be Placed Between the Layers of Straw and Thus Provide a Positive Air Circulation System, Which Will Make the Straw Hat Really Cool



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Scientific Humor

Then Pop "Popped."—A young man said to his father. "Pop do you know that a man invented a clock with a gun on it to shoot every hour?"

Father: "Why does it shoot?"

Son: "To kill time."

—*Henry Boulanger.*

Sort o' Taxidermist.—The Wife: "Isn't that your eye-doctor?"

The Husband: "I thought so till he sent me his bill. He's a skin specialist."

—*W. E. Farbstein.*

How About the "Flying Stone Age."—Professor in Aeronautical History: "Can anyone name the first Aeronautical Journal?"

Voice from the back of the room: "Fly Paper!" —*W. W. Chamberlain.*

Her "Light" Was Out, Too.—It was a cold cheerless night. The wind blew in from the north-east. On the deck of a liner stood a female tourist. Her eye caught the glint of a lighthouse. For a long time she watched it. Then turning to her companion she said: "How patient those lighthouse men must be!"

"Patient? How so?"

"The wind has blown that light out ten times, and each time they have lighted it again. It's simply wonderful."

—*C. E. Etches.*

Must Have Been Painful To Um.—"After the crash," imparted the first hospital surgeon to the second, "I ran over to where it lay on the pavement; and when I raised it up, I saw at once that its ribs were smashed, while a gaping hole was torn in its——"

"Pardon me, doctor," broke in the medical student, who had caught these words as he was about to pass by into the consumptive ward, "but if you have no objections, I'd like to take a few notes on that accident case."

He pulled his notebook from his pocket. "Was the case a child?"

"No," the surgeon informed him to his embarrassment. "I was speaking of my umbrella." —*Pauline Poole.*

A Level Headed Car.—Irate motorist: "Say, this darned car won't climb a hill! You said it was a fine machine!"

Dealer: "I said: 'On the level it's a good car'." —*Victor C. Huebner.*

A Good Substitute: Teacher: "Hawkins, what is a synonym?"

Billy: "Please sir, it's a word you use in place of another, when you cannot spell the other." —*C. Tortanier.*

Would the Light-house Keep'er?—A lady advertised for a servant to do light house work. She received a letter from a girl who said she would like the position, for she thought the sea air would do her good, but she wanted to know where the light-house was situated.

—*H. S. Johnson.*

First Prize $3.00

The Early Bird.—"That's what I call luck," said Ben Franklin, as he got an electric current over his kite string.

"Is your experiment a success?"

"Yes. It shows the advantage of getting in before conditions become crowded. I haven't been told once that the line is busy." —*Harry Steinberg*

It Was a Dark and Stormy Knight.—He: "Why did they call the olden days the dark age?"

She: "Easy, because there were so many knights." —*H. C. V. Carlson.*

Nothing—they're TIRED.—In an automobile salesroom, for purposes of demonstration, was a chassis with the body removed. A salesman was explaining to a prospective woman purchaser the construction of the engine and how it connected with the rear axle and caused the rear wheels to revolve.

The woman seemed much interested in these mechanical details. "Now," she said as the salesman paused at the end of his explanations, "what makes the front wheels go round?" —*Dick Dickinson.*

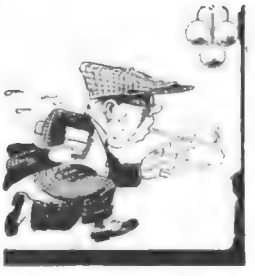
WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

Mexico Seems to Like It.—"War is H——l," exploded the Earth, "I'm tired of having a revolution every twenty-four hours." —*Dorothy Kantro.*

A Run For Your Money.—Sparks: "My doctor advised me to take up motoring for my health; said I needed exercise."

Plugge: "Pshaw, running a car is no exercise."



Sparks: "No, but getting the money to pay for it is." —*C. L. C. X.*

Had a "pull" with his patients.—Lewis: "Do you see that house up there?"

Peter: "Yes, what about it?"

Lewis: "Well, that house has been built with money made from many sufferings, writhings, agonies, and much blood."

Peter: "What beast lives there?"

Lewis: "My dentist."

—*C. Tortanier, Valetta, Malta, Europe.*

And East is West.—"I'm going down to the Postal Telegraph to send a telegram to my brother in California. He just got married."

"You can't send that by Postal!"

"Why not?"

"Why, that's a Western Union."

—*H. S. Johnson.*

He Saw Thru It.—Bixby: "Waiter! Was this chicken cooked with X-rays?"

Waiter: (bewildered) "Why, er-no; that is, yes, yes."

Bixby: "I thought so; I can't see anything but bones." —*A. Maurice.*

Or Breaking Into a Vault.—"How many volts are required to kill a person?"

"One—if it's a re-VOLT."

—*John C. Ealy.*

Some Light On the Subject.—"I've often been told that I steal thru a window," complained the Light Ray, "but this Einstein noise about my being crooked makes light of me."

—*Dorothy Kantro.*

A Heavy Smoker.—"How about that aeroplane?"

"It went up in smoke."

"Burned up, eh?"

"No, made an ascension at Pittsburg."

—*H. S. Johnson.*

Weighed and Found Wanting.—CHEMISTRY PROFESSOR—"Mary, find the atomic weights of sodium and potassium."

MARY (whispering to fellow student) "Jim, have we any atomic weights in this laboratory?" —*Mason Crook.*

And Shocked and Stung.—"That doctor is a regular human dynamo."

"Yes, and when I came in contact with him, I myself was highly charged."

—*Kenneth T. Price.*

"This is no joke," said the Joke Editor.—"I'm in a terrible mess," moaned the Pottage.

"I'm in an awful pickle," groaned the Dill.

"I'm up against the wall," cried the Picture.

"I'm in a tight hole," sobbed the Peg.

"You have nothing on me," answered the Zero. —*Dorothy Kantro.*

"I'm having the H——of a time," said the *Printer's Devil.*

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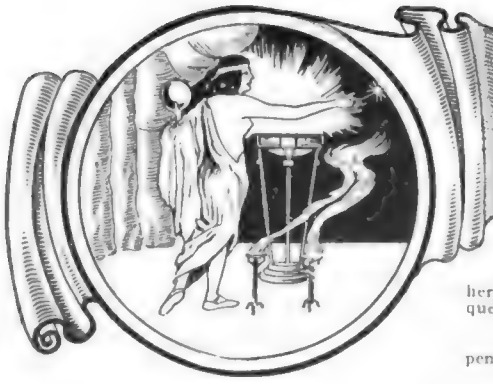

THE ORACLE

The "Oracle" is for the sole benefit of all cientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions address to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Sound and Heat

(1111) Miss Hannah Dvorcef, St. Anthony, Idaho, asks several questions on sound and also wonders why the wires of an electric toaster do not continue to get hotter and burn out.

A. We do not agree with you that sound travels faster thru mere elastic mediums. Sound travels quickest thru a bar of Tungsten steel. A watch ticking at one end of a 30 foot bar can be clearly heard at the other. If this steel should be replaced by an india rubber bar, the watch would not be heard at the other end, and likewise, a vacuum or as nearly a perfect vacuum as can be obtained, will not transmit sound, whereas air will.

This refutes your statements of density, and can be readily established and proved by placing an electric bell on a felt pad in a bell jar and inverting on the table of an air pump and exhausting the air. Its sound cannot be heard.

A person can hear his own voice when speaking in a telephone, but the sound travels so rapidly and we are so used to telephoning, that it is not noticed. If the voice should be amplified thru several vacuum tubes, it can be easily heard.

When a current is flowing thru electric wires, it tends to heat up the wire in proportion to the amount of current passing there thru. When the wire is heated, its resistance increases greatly and less current flows thru and, therefore, the heating effect is not so marked. It loses heat by radiation and conduction, thus establishing a maximum temperature. Thus a certain point is reached with that wire, so that no further heating will take place, unless the amount of current would be increased and a higher voltage used to force it thru the wire.

Electrically Driven Airplanes

(1112) W. L. Dinham, Birmingham, Ala., asks about electrically driven airplanes.

A. Sufficient storage batteries could not be carried in the airplanes of today to furnish the necessary power for driving these machines, particularly when we consider that modern airplane motors are capable of developing from 250 to 1,000 H. P. each. The batteries are too heavy.

There is a plane now being made which connects a generator directly to a gasoline engine. The generator in turn supplies the necessary energy for motors, directly coupled with the propellers.

Thermo-Electricity and Peltier Effect

(1113) James K. Delano, 2 New York City, N. Y., asks several questions regarding thermo-electricity and the Peltier effect:

A. Ever since 1821 it has been known that heat can cause an electric current in a circuit composed of different kinds of metals. Seebeck, who discovered this, joined a German-silver and an iron wire together, forming a complete circuit, and upon heating one juncture while the other was kept cold, he found that a current flowed from the German-silver to the iron thru the hot junction. To complete the circuit, of course, it flowed in the opposite direction thru the cold junction. This effect was named after its discoverer, and by further experimentation it was found that all metals can be arranged in a thermo-electric series such as the following, and that when a couple is made of any two, the current will flow from the one above to the one below, thru the hot junction:

Thermo-Electric Series

Bismuth	Gold
Platinum	Silver
German Silver	Zinc
Lead	Iron
Copper	Antimony

The Peltier effect is produced by passing a current from one metal to the other, either heat or cold being produced depending upon the polarity of the current. It is the converse of the effect described above.

The issue of the *Electrical Experimenter* in which this article appears is the July, 1916, number of page 167, and was one of the articles by Mr. Rogers D. Rusk. This issue is now out of print, but may perhaps be had from some other *Experimenter* reader, or may be found in the files at the Public Library.

Problem in Hydrostatics

(1114) H. H. Davis, Noyes, Minnesota, writes:

Q. 1. Given: a vessel, say a good sized fish tank, and float another smaller vessel partly full of water in this, then connect a filled siphon between the two. Query: will the smaller tank continue to float? If so why, and if not why not?

A. It is obvious that a vessel floating in another vessel and partly filled with water will not have the water level inside the first vessel, as high as the water surrounding it.

In other words, the level outside the small fish globe will always be higher than the level within the globe and therefore in siphoning, connecting the two will tend to equalize the water levels.

This will result in the smaller fish globe sinking down further until eventually it will sink beneath the surface.

Therefore, the small tank will NOT float.

Best Thermos-Couple Metals

(1115) Oscar W. Ehrman, Portsmouth, Ohio, ask a question on thermo-couples:

A. The following thermo-couples are due to Holborn and Day, who used many substances, and found the following to give the best results:

Platinum and a compound of 90% platinum, and 10% rhubibum. Platinum and a compound 90% platinum, and 10% iridium. Platinum and nickel, copper and nickel, copper and constantan.

1000 or 75 ohm Receiver for Telephony?

(1116) Max Fields, Bedford, Ind., writes:

Q. 1. Would I hear better over the telephone if I put a 1,000 ohm receiver in place of the one now in use?

A. 1. We do not believe that you would be able to hear any better over the regular telephone line using a 1,000 ohm receiver in place of the regular 75 ohm receiver.

The reason for this is that the 1,000 ohm receiver is too sensitive and operates satisfactorily on very weak currents. The current which you obtained thru the telephone circuit is relatively larger, and hence the smaller ohmage receiver works more efficiently.

Adding another receiver, however, so that you can hear with two ears instead of one will increase your perception of sound 50%.

Coating on Antenna Wires

(1117) E. B. Gish, Amarillo, Texas, asks:

Q. 1. Please tell me if the black coating on my copper aerial wire will decrease the receiving efficency?

Q. 2. Would it be better to polish the wire?

A. 1. The black coating on your aerial wire does not decrease the ability of that wire to answer the purpose of an aerial for receiving.

A. 2. It is not necessary nor is it even advisable for you to polish the wire of your aerial as radio messages can be received just as well on heavily insulated wire as on bare wire, and this black oxide coating is practically the same as a very thin insulation.

Electric Drive for Small Auto

(1118) Philip Niendam, Warren, Ohio, writes:

Q. 1. Some time back I read an article in your magazine by H. Winfield Secor on building a small auto, to be driven by electric motors geared direct to the wheels.

I am interested in building a car which would weigh about 400 lb. (less the power equipment), and would like to use a motorcycle engine coupled direct to a generator and thus take the juice from it to two motors, one on each wheel—either the rear ones or the front, but as I am not an electrician I do not know what size generator it would require, nor what H.P. engine it would take to turn the same. I would like a maximum speed of about 30 miles per hour on level roads, and at the same time bearing in mind to keep the total weight as low as possible.

A. 1. Relative to building a small automobile to be driven by means of a motorcycle engine driving an electric generator, this generator to supply the necessary current to the electric motors geared to the wheels, would say that this is not a very practical idea on such a small machine, as there are entirely too many losses both mechanical and electrical to warrant the use of such a system in this sized machine.

Underground Radio

(1119) W. W. Stanton, Liberty, Ind., writes the Oracle:

Q. 1. I desire to know what has become of the *Roger's Underground Wireless!* Have not noticed anything about same for some time. Is all the apparatus of this system made just the same as the regular style of Wireless Instruments, only connected to the ground in a different manner? In other words, could a tower station be changed to Roger's Underground type, by using a few special connections, or would different kinds of instruments have to be used altogether?

About what would be the lowest cost of an amateur *long range* receiving station of the Roger's Underground Type? Will the Roger's Wireless pick up telephone messages just as well as the telegraph signals? Does *any type* of wireless receiving station have to be arranged specially for getting wireless telephone conversation, music, etc.? Are there any manufacturing companies now supplying complete amateur apparatus for the Roger's Underground Wireless system? If so, kindly give their names and addresses.

A. 1. Replying to your recent communication with reference to the Roger's Underground Wireless, would say that when Mr. Secor wrote the first complete article on this system, he had at that time visited Dr. Rogers in his laboratory at Hyattsville, Md., and you may address Dr. Rogers at that address.

There is nothing special about the apparatus used with the Rogers underground radio system, excepting the various ways in which the antennae may be arranged. Any of the standard vacuum tube receiving apparatus can be used in connection with this system, for radio telephone and radio telegraph reception.

There were a number of articles that were publisht on the Roger's system from the experimental and amateur viewpoint in the *Radio News* magazine and you can get full information on this subject by writing to Mr. Lacault, Associate Editor, of *Radio News*, 233 Fulton St., New York City. Mr. Secor's very complete article on the Roger's Underground System appeared in the March, 1919, issue of *Science & Invention*.

Magnavox Queries

(1120) C. E. Rugh, Abilene, Kansas, asks:

Q. 1. Several queries on building a Magnavox as described in *Radio News*.

A. 1. With regard to query on the Magnavox loud talker, as described in the October *Radio News*, the data and method of procedure in redesigning the electro-magnet coils for different voltages is explained clearly in the *Oracle* column of the June, 1921, issue of *Science & Invention*.

In answer to your second query in reference to winding the movable diafram coil with a resistance of 500 to 1000 ohms with proportionately finer wire, this will be all right and might require a little experimenting to obtain just the right resistance for given circuit conditions. The movable coil would be connected across the terminals of the vacuum tube circuit in the place of the usual telephone receiver—that is all there is to it.

Blacksmith shops and hardware dealers usually handle a good grade of soft wrought iron.

Secret Message Code

(1121) A. S. Brubaker, Santa Fe, Kansas, asks:

Q. 1. For a good and not too easily decipherable code.

A. 1. The best code for messages is that employed by the U. S. Army. It consumes a little time to be sure. The alphabet is arranged as follows:

abcdefghijklmnopqrstuvwxyz
bcdefghijklmnopqrstuvwxyza
cdefghijklmnopqrstuvwxyzab
defghijklmnopqrstuvwxyzabc
efghijklmnopqrstuvwxyzabcd
fghijklmnopqrstuvwxyzabcde
ghijklmnopqrstuvwxyzabcdef
etc.

The code word is agreed upon or sent in writing to the party, as for instance, the word "Hero." Supposing now that you are transmitting the message, "Buy up 200 shares of B & O stock." You write the code word above the message, thus:

heroheroheroheroheroheroher
Buyup200sharesofBandOstock.

Now look for h, the first letter of the code word, in the horizontal column and b, the first letter of the message, in the vertical column at the extreme left, and the point of intersection of the letters will be the letter transmitted.

Example:—Suppose "hero" is the code word and we are transmitting "cage ace"; we will place the letters of the code word above the letters of the message, thus:

heroher
cageace

Then looking for h in the horizontal column and c in the vertical column at the extreme left, we get the letter j at the point of intersection; then look for e in the horizontal, and a in the vertical, and we get e; look for r in the horizontal and g in the vertical and we get x, etc. The message thus coded is jexshgv. In transcribing the process is simply reversed inasmuch as the code word is known by both parties. This is the most difficult code to decipher to anyone not "in the know."

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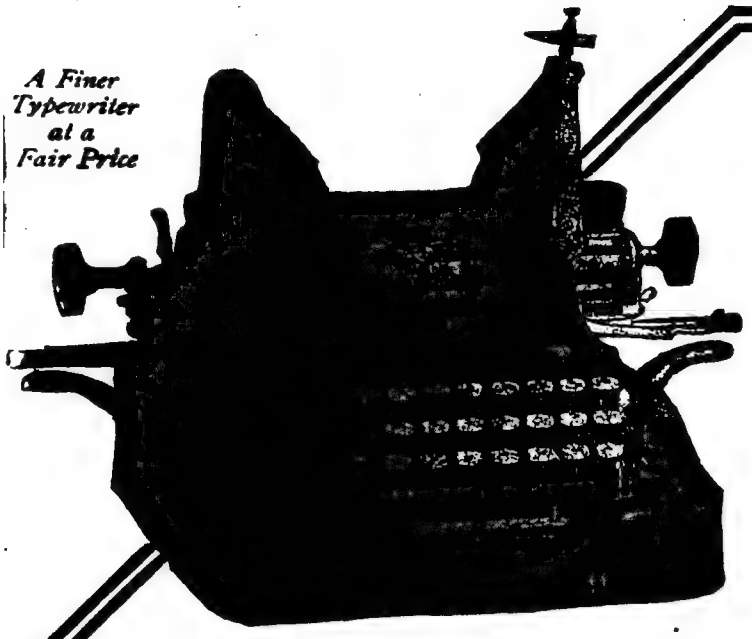
A Finer Typewriter at a Fair Price



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If you don't want to keep the Oliver, simply send it back at our expense. If you do agree that it is the finest typewriter, regardless of price, and want to keep it, take a year and a half to pay at the easy rate of only $4 a month.

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No pre-payment required. This is a real free trial offer. All at our expense and risk. Fill out and mail the coupon and get the Oliver for free trial. If you should wish further information before requesting a free trial, mark the coupon for the free books mentioned therein. Clip and mail the coupon now.

Canadian Price, $82

The OLIVER Typewriter Company

67A Oliver Typewriter Bldg., Chicago, Ill.

THE OLIVER TYPEWRITER COMPANY
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This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book —"The High Cost of Typewriters — The Reason and the Remedy," your de luxe catalog and further information.

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Book Review

ORGANIC PHOTOGRAPHIC DEVELOPERS, by Samuel Wein, 128 pages, two indexes. Cloth covers, size 6 by 9 inches. Publisht by Forty-Second Street Commercial Studio, New York.

This is a very convenient manual, giving the names and formulas of a very large number of photographic developers. In many cases, the manipulations and processes required to manufacture them are given in some detail, and the field seems to very fully cover many of the compounds described. Sometimes the patent is called upon, and sometimes scientific publications, for the description.

The book shows a great amount of research and painstaking on the part of the author. When the compounds involving the benzol ring are reached, graphic formulas are given as required.

The second section of the book is devoted to the use of the different developments and other photographic processes such as developing, factorial development, bleaching and intensifying, and toning. A considerable section is devoted to the diazotype process, and the much debated subject of direct positives has a chapter.

One interesting chapter describes the making of plaster plaques, by the aid of photographs.

THE AIRPLANE. A Practical Discussion of the Principles of Airplane Flight. By Frederick Bedell, Ph.D. Profusely illustrated. Cloth covers, 6¼" by 9¼", 257 pages. Publisht by the D. Van Nostrand Co., New York.

Dr. Bedell in this book has produced a very timely and concise presentation on this subject. It starts with the subject of sustentation which after all is the great thing; for this is what constitutes the airplane. The subject is quite elaborated by diagrams and graphs. It is very interesting to see how the partial vacuum existing upon the cambered airplane wing is produced, for it is now known that the lift of the airplane is largely due to this vacuum.

It is a difficult book to review, because while brief, and in spite of the fact that everything is presented in a very simple manner, it really covers a wonderfully large field.

Power required, power available, climbing, flight, effective altitude and performance and longitudinal and lateral stability, are some of the subjects treated. A short glossary taken from a report of the National Advisory Committee for Aeronautics ends the text, and a quite adequate index follows.

RADIO ENGINEERING PRINCIPLES. By Henri Lauer, B.S. and Harry L. Brown, B.E.E. Fully illustrated. Cloth covers, 6¼" by 9¼", 300 pages. Publisht by the McGraw-Hill Book Co., New York.

Before the authors' preface in this work, is given a foreword from General Squier, the Chief Signal Officer of the U. S. Army, expressing warm commendation of the book. It certainly presents a most attractive appearance and covers its subject very thoroly with a minimum use of mathematics. The latter is not said in simple commendation, but merely as a statement of fact, because if one does go into the subject exhaustively, it is futile to attempt to avoid formulas which are so often dreaded by the reader. Yet the authors of this book show no desire to avoid formulas,—they simply use them where required, but the majority is straight reading text, liberally illustrated and brought well up to date.

The history of radio science is the history of discarding, and it is curious to notice that in this book, which is very complete, the Branly coherer, which in a sense was the parent of radio communication, is not even indexed.

The illustrations are very attractive and pertinent to the subject. There is no index.

NAVAL CONSULTING BOARD OF THE UNITED STATES. By Lloyd N. Scott, 46 illustrations. Cloth covers, size 5¾" by 9¼", 288 pages. Publisht by the Government Printing Office, Washington, D. C.

The work of this all important board is given in the text of this book in suitable detail, and yet so interestingly written, as to make good reading. The best scientists of America were at the service of this organization and their work in the scientific field is very fully given.

Ship protection, ship propellers, the consideration of inventions presented from all parts of the country, the discrimination of the good from the bad of these inventions, and the work of the members of the Board in these lines are all treated in suitable detail. Numerous illustrations give interest to the work and in a sense make it better reading.

An interesting portion of the book is devoted to the work of Thomas A. Edison, who with his combined inventive ability and great power of systematizing data and drawing conclusions from observations and reports, really did wonderful work in the way of protecting ships from submarines. An interesting tribute to Mr. Edison, was given by the S.S. *Valerie* of the Cunard Line. This ship was camouflaged according to Mr. Edison's method, and the great inventor was told from outside sources that she ran for a year by herself, and it was only when put in a convoy that she was torpedoed and sunk.

The obvious deduction is that if all ships were as adequately camouflaged they would have been better protected without a convoy, and that the latter would really have been a source of danger.

Mr. Edison's under-water searchlight, his sky line smudging, his protective systems for ships, and his other investigations and accomplishments reveal his wonderful powers. After Chapter 11, whose 31 pages are entirely devoted to Mr. Edison's work, come the achievements of other engineers such as Elmer A. Sperry of gyroscope fame, Dr. Peter Copper Hewitt, Dr. Bakeland, and many others.

To the unprejudiced mind, it would seem that the government in so important a publication might set an example by a more complete table of contents and by an index. The latter we are sorry to say, is entirely omitted.

EASY LESSONS IN EINSTEIN. A Discussion of the More Intelligible Features of the Theory of Relativity. By Edwin E. Slosson, M.S., Ph.D. Clearly illustrated. Cloth covers, size 4¾" by 7¼", 123 pages. Publisht by Harcourt, Brace and Howe, New York.

The only criticism we can make on this work is ike the remark of the farmer when he first saw a giraffe,—"There ain't no sech enimal!" Lessons in Einstein are not easy, but if anybody can make them easy, vivid and interesting, it certainly is Dr. Slosson. We are a little sorry to see him taking up the fourth dimension as he does, even to the extent of showing how to draw a fourth dimensional figure and giving a picture of the tesseract.

It is said that there are only twelve men in the world who can really follow Einstein's mathematical developments of his theory. It is interesting to know that one of them has been retained at the Eastman Kodak Co. for service in their great institution at Rochester, N. Y.

THE EINSTEIN THEORY OF ELECTRICITY. By Prof. H. A. Lorentz. Hard covers, size 4¾" by 7½", 64 pages. Publisht by Brentano's, New York.

Dr. Lorentz in 40 liberally leaded pages, gives a resumé of the Einstein theory, calling it very justly a concise statement, which proves that the eminent Hollander has undertaken too great a task. 24 pages of introduction helps to fill up the book, and its limited size really indicates that the omission of an index is hardly a subject for criticism.

FUNDAMENTAL ELECTRICITY. By W. P. Wieman. Cloth covers, size 4¼" by 6¼", 128 pages. Publisht by the Weiman Co., Pittsburg, Pa.

Whatever we may think of the peculiar views of the author, there is a certain amount of attractiveness in the way in which he presents the subject, and some of his illustrations are certainly picturesque if fantastic.

ELECTRIC THEORY OF THE SOLAR SYSTEM. By Frank S. H. Close, 4 diagrams. Cloth covers, size 5½" by 8½", 19 pages.

This little pamphlet comes from far off New Zealand, from the well known city of Waihi, and for any reader who desires to follow out these attempts at explaining what may fairly be termed one of the great mysteries of science, we can simply commend this as one among many works which may be perused.

THE PRINCIPLES UNDERLYING RADIO COMMUNICATION. Radio Pamphlet No. 40. Signal Corps, U. S. Army. Fully illustrated. Cloth covers, size 4½" by 7½", 355 pages. Publisht by the Government Printing Office, Washington, D. C.

In this work designed for field use, which the binding in its substantial nature indicates, the subject is treated from the very ground up, so that a great part of the book, nearly half of the text, is devoted to elementary electricity.

The reviewer is inclined to agree with the ideas of the author as far as indicated by the book, to the effect that the preliminaries of electricity should be better understood by radio operators, and we are glad to see in this work so much space devoted to the elements of the science.

Unfortunately, it is rather a way with the government publications to have no indexes, altho a rather full table of contents replaces it to some extent.

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$1-60^{*}-\sqrt{90}$

(*Continued from page 220*)

164 large
164* larger
164** largest.

The word "and" is expressed by the plus sign +; thus 1 + 2 indicates "I and you."

If numbers have to be indicated they are put in parentheses. Thus the expression 1-30-(3)-980² indicates "I will write three letters." Words can be formed from their roots; if for instance 1673 means "color," then > 1673 means "colorable," 1673 < means "to color."

This is an abstract of the system, which it is evident is exceedingly simple. Without further explanation it is clear that two people speaking different languages, can at once understand each other, if each of them has a little dictionary, in which words are alphabetically arranged, with the numbers expressing them in one division of the book, while in the other division numbers are given in order, followed by their meaning in words. There is to be a dictionary, of course, for each language. A collection of 7,000 numbers can express 10,000 to 12,000 meanings. If a parallel idea is to be stated for different lines of work, for instance, in technology, pharmacy, etc., a secondary meaning may have to be given and this is arranged in an appendix and a letter T is placed before the word. This will indicate that the meaning is not to be found in the first book, but in the appendix.

A whole number of trials, that were carried out with sentences written on a blackboard, with readers selected as knowing each one his own language, demonstrated how exceedingly quick and simple this system is in operation, something which in the ensuing discussion appeared very evident.

Is There a Sixth Sense?

By JOSEPH H. KRAUS

(*Continued from Page 217*)

and should the hole be criss-crost by fine wires or threads, the bat will make no attempt to get thru. The writer does not believe that a sound reflection in this case would account for the fact that the bat staid away from the hole; neither can the sense of touch, as we know it, account for this phenomenon.

Sensing Earthquakes.

In 1897, on the Riviera, just before the earthquake, the following facts observed by scientists, investigating animal life, may be of interest. Not less than 42 authentic cases were reported, comprising horses, dogs, a monkey and even ducks, in which cases these animals definitely showed signs of panic, some of them three days and others two days, before even the slightest trembling of the earth was noticed.

Earthquakes particularly, have a very terrifying effect upon animals, such effect is also seen during thunder storms. In all probability it is not due to the sound of the thunder itself, but to some etheric disturbances or vibrations set up during the storm. Human beings are not so susceptible to these vibrations as animals are. Would we then call this the sixth sense, or is it also an exaggerated sense of feeling? It perhaps may be due to the fact that the barometric pressure varies. In the Alps Mountains, the Swiss cattle which wander around, feeding in the upper pastures, do not run to shelter during light thunder storms, often hours before a

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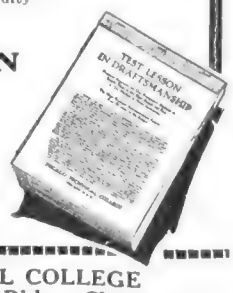

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heavy storm takes place, they come galloping down the rocky paths to their milking ground, following in the wake of the head cow of the herd. They bunch together and are followed by the goats and sheep. Even animals which are enemies to each other ordinarily, will be found to be perfectly quiet and submissive under these conditions. Barometric depressions we know, precede storms for many hours.

Let us also attempt to explain bird migration. We know now that birds have a great sensitiveness to changes in temperature; the birds interpret a rise in temperature as a summons towards better climates suited more for their needs and food supplies. Most of these migrating birds return to the nests which they had occupied the preceding year. This would indicate the superior development of the sense of feeling and smell, far better developed than in the human individual. But can we really spread out our imagination so that it will take in this case as one of the normal senses, as we know them? If so how will we account for the peculiar power which birds have of determining direction? Some of these birds will migrate towards the north, flying both day and night—and surely at night they do not see where they are going! "The magnetic force of the earth controls this," you may say.

How Do Carrier Pigeons Find Their Way?

Yes, perhaps such an answer may be puzzling for a moment, but consider that pigeons of the carrier type, have been set free 2,000 miles from the shore, and have arrived at home, traveling in a westerly direction towards the American shore, instead of toward the nearest shores, or those of Europe. It has been found that if they flew both day and night they would have traveled at a speed of almost 100 miles per hour; and it is remarkable to note that they do not fly at great altitudes so that their sense of vision could help them, but in fact seemed to proceed westerly very close to the surface of the ocean, with consequently a very small field of vision. Can we attribute this sense of direction to a "sixth sense?"

Experiments with blind people have shown that a person suffering from loss

The Manner in Which a Bat Folds Its Wings is Interesting as is the Peculiar Formation Found Upon the Wings. These Tiny Strial are Supposed to be Nerves.

of vision will walk toward a wall and instinctively stop two feet away from the wall. Several scientists have claimed that the blind people can read thru their backs. At any rate, the senses which we now have are certainly sharpened greatly by the loss of one or more of them, and there is no doubt that eventually the world will come to recognize not only a sixth sense but perhaps many more higher ones which cannot be attributed to the classes of smell, taste, touch, sight and the auditory sense unless these are broadened far beyond our present knowledge.

Liquid Carbon

By Dr. ALFRED GRADENWITZ

(*Continued from Page 229*)

vincing results. A Russian scientist, Prof. J. Plotnikoff, during the war, succeeded in softening and bending thin carbon rods.

A definite tangible, experimental proof of the fact, that carbon in the electric furnace at ordinary pressures can be liquified, has only recently been obtained by E. Ryschkewitsch, at the Physico-Chemical Laboratory of the Kropfmühl Grafite Works. The experimenter in this connection availed himself of direct resistance heating, the sample constituting a resistance inserted in the electric circuit and heated by the current. This resistance consisted of grafite in a box formed of carbon plates, the electrodes being likewise of carbon with neatly cut ends accurately fitting into the box and immediately touching the grafite.

Now, in connection with some experiments, a surprising fact was brought out, the sharp-cut inner edges of the carbon electrodes undergoing a radical change of form, with gradual, rounded-off intermediary portions, as tho the carbon there had been flowing down. On cutting thru the bulbous portion, there could even be distinguished individual layers of solidified liquid carbon, successively formed in several experiments. Some electrode portions would be covered with numerous solidified drops of an intense metallic-grey polish, which consisted of soft pure grafite.

In one case, the upper carbon plate, forming the top of the electric furnace and resting on the cut electrode ends, was found to be fused to the two electrodes and to be bent downward in a marked degree. On being broken off the electrode ends, the carbon plate was broken, not at the molten portion, but with an electrode fragment adhering to it.

Chemical analysis showed the melting to be produced in pure carbon without any admixture. In fact, the temperature of liquefaction is so high that any impurities would long ago have escaped in a gaseous condition.

Theoretical considerations go to show that the melting point of carbon is not far removed from the temperature at which carbon tends to pass into a gaseous condition.

The molten product in all cases is, not diamond, but pure, soft grafite, exhibiting a strong metallic polish. The diamond hypothesis is thus definitely disproved.

The heating effect was continued for a considerable length of time, up to 11 hours, thus ensuring a thoro heating of the electrode ends and the permeation of the heat thru the whole of their mass. In all previous cases, there had only been a very short heating effect, the highest temperature being confined to quite minute areas, and possible traces of melting therefore being virtually invisible. Moreover, the simultaneous sublimation of some carbon (direct passage from the solid into a

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gaseous condition) would render these traces even more indistinct. Finally, the current densities used by previous investigators in the same field had invariably been much higher than in the present case.

The melting point of grafite, on account of the design of the furnace, could not yet be determined.

The accompanying photographs, taken by Prof. Oebbeke, at the Mineralogical and Geological Institute of the Munich Technical High School, bear out the undoubted reality and striking character of the indications of melting carbon. Fig 1 shows the surface of the molten portion of the electrode, covered with minute solidified drops. These drops are, in Fig 2, shown considerably magnified, the transition from the crystalline grafite into the homogeneous molten mass being quite striking.

Fig. 3 finally refers to an experiment now being made with a somewhat modified apparatus, a short rod being heated very intensely and partly melted by strong currents at low-tension in a small furnace having carbon walls. A carbon drop, bright as silver, and solidified on cooling, is distinctly seen at the end of the carbon rod. The drop consists of very soft grafite.

The Power of Lightning

By A. H. SCOTT

(*Continued from page* 211)

the bottle is unable to stand the strain and is broken up.

The theory is further upheld by the known action of and damage done by potentials induced on transmission lines by lightning discharges. On transmission lines of the lower class of voltages, damage is frequent from this cause, but on systems of 100,000 volts and over there is almost complete freedom from damage by lightning stroke. As high voltage lines are struck relatively as often as those of lower voltage there can be but one conclusion, namely, that the protective devices and insulation provided on these higher voltage lines is sufficient to withstand the voltages induced by lightning strokes. As all disturbances on transmission lines due to lightning are caused by what is known as secondary or induced surges of voltage, the primary or lightning flash voltage which induces them has been recently estimated by Dr. Steinmetz to have a value approximating 50,000,000 volts. This voltage, as pointed out above, is but a fraction of the potential, which would be present, if its value could be computed solely on a basis of the length of flash.

As the actual work done appeals most directly to our senses, let us compare the observed effects of lightning, such as its illuminating power and heating and destructive capacity of similar known values of artificially produced electrical effects. The lighting power of a lightning flash occurring in the daytime is negligible even with the storm clouds obscuring the sun, but at night it will light up a territory of several square miles in extent with a degree of ilumination nearly equivalent to the intensity of daylight. To a person sitting in a well lighted room at night a flash will be seen to thoroly illuminate objects outside, while not materially affecting the light intensity within the room, indicating that the amount of light per unit area inside is about the same as that momentarily present outside.

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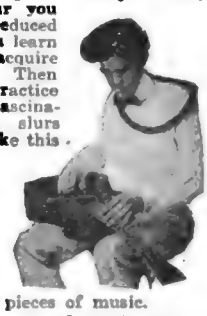

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Allowing 10 watts, or five candle-power per square meter required to illuminate a room to the intensity of daylight and double this value outside where there are no reflecting walls, it would require 800,000,000 watts to light up two square kilometers. As the lighting effect of the flash apparently persists for one tenth of a second the power would be eight million watt-seconds or eight thousand kilowatt-seconds, but due to the absorption of light by clouds and moisture in the lower atmosphere to the extent of approximately fifty to ninety per cent, the lighting effect finally apparent to the eye would be that produced by an average of 30,000 kilowatt-seconds or ten horse power hours.

By referring to his monthly light bill, the average householder will discover, that this amount of power, corresponding to seven and one-half kilowatt-hours, would light his house for only about ten days during the winter months or for about one month in the summer-time.

The destructive effect of lightning has been observed by nearly everyone and might correspond to that which would be caused by the short-circuiting of the municipal power plant of a city like New York or Chicago. When the power of such a plant gets beyond control momentarily, a huge generator, transformer, or switchboard is usually wrecked or damaged to about the same extent, as when such apparatus suffers from the effect of a lightning stroke. A great many flashes however, altho accompanied by great momentary brilliancy and a deafening report, are capable of merely ploughing a narrow furrow in the bark of a tree or of making a few odd looking holes in the ground which could be duplicated by a man with a pickaxe in a short time.

Altho a thing to be feared and to which we should not unnecessarily expose ourselves, we should keep in mind when watching a summer evening's electrical storm, that the accompanying lightning is somewhat like the proverbial dog, whose bark is worse than his bite, and that the earth is not actually going to be rent asunder by it.

WHAT TO DO IN A THUNDER STORM

If you are out of doors in a very severe electrical storm, it is well to observe the following rules for your own protection:

1. Keep away from wire fences. They may carry a dangerous electrical charge long distances. Cattle in pastures are frequently killed thru the neglect of farmers to ground the wire of the fences.
2. Keep away from the hedges, ponds and streams.
3. Keep away from isolated trees. Oak trees are frequently struck; beech are seldom struck. It is safe in a dense forest.
4. Keep away from herds of cattle and crowds of people.
5. Do not hold an umbrella over you.
6. It is safer to sit or lie down in an open field than to stand.
7. Drivers should dismount and not stay close to their horses.
8. Do not work with any large metal tool or instrument.

If you are indoors:

1. Keep away from the stove and chimney. The hot gases from the chimney may conduct the lightning to and down the chimney.
2. Do not take a position between two bodies of metal as the stove and waterpipe, for example. An exception to being near metals is the case of an iron bed. One of the safest places is on the mattress in an iron bed,—provided you do *not* touch the metal. The metal surrounding you makes a safe cage which will prevent the lightning from reaching a person inside.
3. Do not stand on a wet floor nor draw water from the well or faucet.
4. Do not stand directly under a chandelier, near a radiator, nor on a register.
5. Do not use the telephone in suburban districts. In cities there is practically no danger, as the wires are placed underground.

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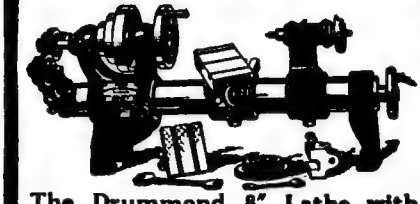

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Diamonds from the Electric Furnace

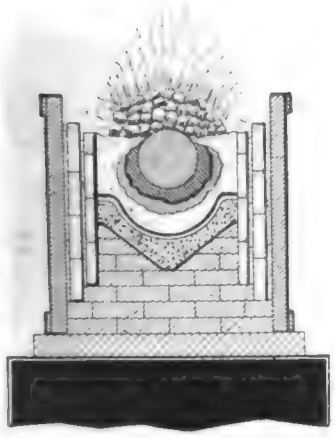
(*Continued from page 214*)

F. and 3632° F. will separate from the bath. This excess remains in suspension in the melted iron, but out of combination, exactly as crystals of sugar can be seen to form in a solution saturated at a high temperature and then chilled.

If now we dissolve, by means of acid, the iron after it has cooled, we will find in this the excess of carbon which has been set free in the form of grafite of amorphous carbon and of diamond.

It is precisely by such series of operations that Marsden in 1885 using a bath of melted silver as a solvent of carbon, succeeded for the first time in getting microscopic diamonds artificially.

A few years later, in 1893, Moissan conceived the idea of using high pressure to prevent the carbon set free from taking the grafitic form, so as to transform it directly into diamonds. Inclosed in a little steel crucible, a mass of melted cast iron is saturated with carbon, this arrangement preventing the increase of volume, which would normally take place on cooling. (Editor's



The Boismenu Electric Furnace. The Hearth of the Furnace is Made of Two Courses of Refractory Bricks, Laid Flat and Covered with a Layer of Refractory Stones, Which Give a Wide V-Shaped Bed of Fusion. Into the Channel thus Formed, a Powder Composed of 80% of Lime and 20% of Retort Carbon is Rammed. Eventually the Electrodes, One of Which is here Shown in Section, Become Immersed in a Veritable Trough Full of Melted Calcium Carbide, Afterwards Solidified, Which Covers and Adheres to Them and Protects Them Perfectly.

note: The allusion is to the fact that cast iron, like water, expands when it assumes the solid state.) In this way he effected in the interior of the liquid cast iron, the production of high pressures, which brought about the formation of minute crystals of diamond.

In 1898 M. Rossel, professor in the University of Berne, demonstrated the presence of diamond obtained in certain hard steels by compression.

Finally, we must note the more recent experiments of Rousseau and of von Bolton, who also succeeded in producing traces of diamond by the methodical decomposition of certain gaseous hydrocarbons.

But all these processes could never do more than produce extremely small crystals, whose form and appearance could only be revealed by the microscope and of which no satisfactory analysis was possible.

But the method of production which we are about to describe has on the con-

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Paul C. Oliphant, from Warren, Ohio, wrote:

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trary given real cleavable diamonds, susceptible of cutting and whose volume was four or five hundred times that of the largest crystals obtained by Moissan. This method marks then a considerable progress and seems susceptible of leading to important results.

This process like that of Moissan, starts off with the treatment of a bath of fused metallic carbide, but with the essential difference that there is no pressure, and introduces another form of energy, electrical, to start and to maintain the separation of carbon.

We have selected a substance very rich in carbon, calcium carbide, CaC_2, whose composition is 62.5 per cent of calcium and 37.5 per cent of carbon. Thus from one hundred parts by weight of this carbon, we can theoretically separate 37 1-2 parts of carbon, while, in treating cast iron saturated with carbon, we can only isolate the carbon in excess of that which remains in combination as we have explained above.

Upon a hearth or bed of powdered quick lime strongly rammed, contained in an electric resistance furnace, the carbide of calcium to be treated is placed and then thru this mass a direct current of electricity of high intensity at low tension is passed.

Subject to Joule's law, due to the passage of this current, the carbide melts at about 5,000° F to a liquid bath. The electrolytic action of the direct current comes into play in separating the elements of this bath. In accordance with the law of electrolysis the calcium goes to the negative pole; there it burns, producing flames of a characteristic strong pink color. On the other hand carbon, set free at the positive pole, crystallizes under the form of diamond in the slag produced by the decomposition of the carbide, where we have found it.

Such is the principle of the method which we have applied to the synthesis of the diamond.

Arranged especially for these experiments the laboratory contained two D. C. dynamos each good for 800 or 1,200 amperes with a voltage varying from 15 to 20 volts; they were driven by an electric motor connected to the Public Service lines. In this way we could use about fifty kilowatts.

As to the furnace, following out the lines of the Atcheson furnace with horizontal electrodes used in making carborundum, there was a rectangular chamber of refractory material, three-quarters filled with quick-lime in powder, well rammed, forming a protecting and insulating layer.

Into the interior there penetrated two cylindrical electrodes 6.6 inches in diameter, arranged to be fed by hand so as to be brought nearer together or else separated.

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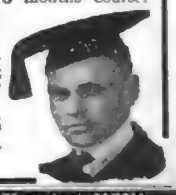

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First Large Diamonds Produced.

After ten fruitless operations in the course of which the most favorable conditions were sought for, the first tangible success was obtained on April 13, 1908; on that day the furnace had worked regularly for six hours with a mean current of 800 amperes at a pressure of 32 volts, and the bath of melted carbide had been freely decomposed by the electrolysis.

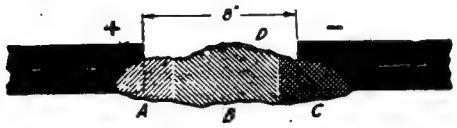
The definite proof of this was given on the next day, when we examined the mass of cooled solidified carbide. Its appearance was exceedingly characteristic.

In all the positive region the carbide seemed, by the color fracture and size of its crystals, to have become richer than on its introduction into the furnace. The negative region on the contrary, neither in appearance nor in properties, showed the least similitude or resemblance to calcium carbide.

It was a sort of black slag, light, brittle, lamellar in places, and as it was more distant from the electrode, presented little by little a vitreous aspect and a grayish and blue color. It was full of holes and openings like a sponge.

This slag had totally lost its action on water; in a word, it was no longer in any sense calcium carbide.

All this portion thus decomposed was separated from the block of carbide and submitted to a careful examination after having washed and dried it; a gray powder was obtained in the midst of which we had finally a vivid satisfaction of seeing the scintillation of little crystals.



Effect of Electrolysis on Calcium Carbide. After Treatment the Cold Carbide is Hard, Compact and Well Crystallized in the Positive Region, A. In the Center B, it Retains Its Original Composition, and at C it is Freely Decomposed. Superficial Signs of Ebullition are Seen at D.

A simple manipulation by hand separated some forty of these crystals, varying from a 35th to an 18th of an inch in diameter, and a considerable quantity of smaller crystals.

Examined by the microscope, with a magnification of 20 diameters, these crystals showed a great resemblance in appearance to the natural diamond.

Some showed facets and angles, both curved, so characteristic of the natural diamond and subjected to various impingements of rays of light they gave rise to remarkable scintillations. Of extreme hardness they easily scratched glass and steel, and finally, when immersed in methylene iodide, they showed a specific gravity of about 3.5, sinking slowly to the bottom of the test tube, when no transparent crystal, with the one exception of the diamond, will thus sink.

In advance of the official analysis which will confirm it later, we can now be convinced, that we have realized the synthesis of the diamond.

Another experiment executed the day after under identical conditions and which lasted 6 1-2 hours, confirmed the first one, and gave analogous results.

Size of Diamond Depends Upon Time Current Flows.

Encouraged by these results, the series of experiments was continued, trying to perfect it by the slight modifica-

". . . places far apart are brought together, to the present convenience and advantage of the Public and to the certain destruction, in time, of a host of petty jealousies, blindnesses and prejudices, by which the Public alone have always been the sufferers."
From Charles Dickens' Preface to Pickwick Papers.

The Advance of Understanding

Even romance of sixty brief years ago could not imagine the great advance heralded by the passing of the stage coach. The railway and telegraph were coming into their own; but the telephone had not been so much as dreamed about.

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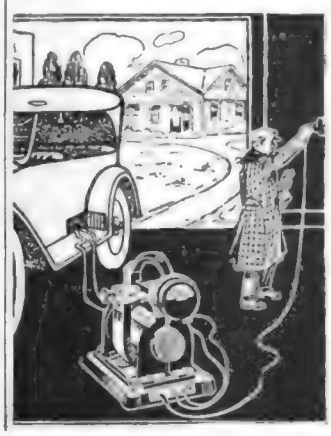

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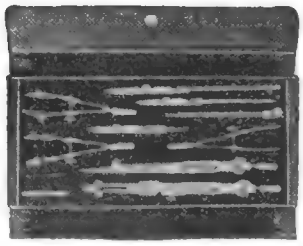

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tion and above all in prolonging its duration; the moment we begin to think of crystallization, it seems certain that the size ought to be a function of the length of treatment.

This view was soon confirmed on the 20th and 24th of April; the operation was kept up for nine hours, and stones and crystals were collected of a distinctly larger size.

Experiments of 11 and 12 hours duration, always with a mean current of 800 amperes and a pressure of from 28 to 32 volts followed, giving each time larger and larger crystals.

Unfortunately the electric light people refused to give current during the hours of public lighting, which prevented us from prolonging the operation for more than 12 consecutive hours.

A series of seventeen experiments was carried on from April 30th to June 5th, of which four gave poor results and thirteen were perfectly successful.

Photographs accompanying the original article show, under a uniform magnification of ten diameters, some of the crystals of diamond obtained in the course of these experiments. It is clear that there exists a close proportion between their size and the duration of the operation producing them.

In the experiments which lasted only six hours, the largest crystals never exceeded 1-16 of an inch in diameter.

In the duration of nine hours, they are about 1-12 of an inch in diameter, 1-10 of an inch in 11 hours, and nearly 1-9 of an inch in 12 hours.

In the conditions under which we worked, the development of a crystal seemed to take place at the linear rate of 1-125 inch per hour.

This may be only a chance factor, but if this rough law is confirmed, and there is no reason why it should not be confirmed, 48 hours of continuous operation should give stones of 1-3 of an inch diameter and in 72 hours or three days gems of nearly 3-4 of an inch diameter, weighing 50 or 60 karats should be produced.

We will be lost in the phases of the improbable and the absurd, if we suppose that this progression will follow our regular progress for an indefinitely unlimited time, but on the other hand there is no absurdity in believing that today we can obtain beautiful synthetic diamonds with relative ease.

It would not be a question of greater or less force to be applied but simply a question of time, never exceeding a few hours.

The crystals which we have thus prepared are pure crystallized transparent diamond, generally of good quality, absolutely the same as those we find in nature. They can be cut, cleaved worked and polisht like a natural diamond, and nothing so far has authorized the establishment of any difference between them.

Two learned professors, members of the institute, have kindly undertaken to analyze them, to determine their nature, chemical and physical.

They have found and announced on one side that their hardness, their specific gravity, their index of refraction, the dihedral angles of their crystals, could only be referred to the diamond, and on the other hand, that their combustion in oxygen gave precisely the proportion of carbon dioxide corresponding to pure carbon.

There cannot be the least doubt as to the nature of these crystals which are transparent crystallized carbon, that is to say true diamond.

This new method properly perfected, enables us to make diamonds in large quantities at an absurdly low cost.

$2.00 BRINGS A Satisfactory Tire

Save One-Half

Size	Tires	Tubes	Size	Tires	Tubes
28x3	$5.25	$1.50	34x4	$ 8.75	$2.60
30x3	5.50	1.60	34x4½	10.00	3.00
30x3½	6.50	1.75	35x4½	11.00	3.15
31x3½	6.75	1.85	36x4½	11.50	3.40
32x3½	7.00	2.00	35x5	12 50	3.50
31x4	8.00	2.25	36x5	12.75	3.65
32x4	8.25	2.40	37x5	12.75	3.75
33x4	8.50	2.50			

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Fortunes from Little Things

By CHARLES FREDERICK CARTER

(*Continued from Page 21*)

of the largest, if not the largest, manufacturing establishment in the world.

O'Sullivan devoted most of his time and thought to advertising. He studied mediums as well as modes of expression. He felt that if he could identify the name O'Sullivan with rubber heels he need never worry about competition. His advertising appropriation never exceeded $150,000 a year—but being a clever bargain hunter, he made people think he was spending twice that sum.

It was his command of the English language, plus his practical knowledge of the printing trade, plus a keen understanding of human nature, which made his advertising campaign a brilliant success, but he had to work day and night. It wasn't many years before the pace became too fast, so he sold out to some New York men who organized the O'Sullivan Rubber Company. Andrews, finally was able to wash his hands of that rubber-heel affair, receiving $240,000 cash for his interest. O'Sullivan still retains heavy stock holdings.

Hay Fever—Its Cause and Cure

By DR. ERNEST BADE

(*Continued from page 212*)

green and is in flower and when the air is mild and warm. Then one gets a more or less violent catarrh which attacks the eyes, the nose, and the larynx.

The first symptoms are an itching and reddening of the eyes, and a predilection to sneeze while in the open. Besides these symptoms the patient has a complaint of the gums, asthma, and an itching and swelling between forearm and the fingers. Fever is seldom present in spite of the name of the sickness, but headaches and a general lassitude and weariness prostrates the body. When one remains quietly in the room the attack is not so violent, but when taking a trip or when out of doors it ofter becomes unbearable.

During the last few years successful attempts have been made to isolate the socalled "poison" and so make the body immune. A vaccine has been secured from grain and grass pollen. This is brought under the skin about every third or fifth day. The immunization must be begun at an early period—in February—so that the body may become immune when the grasses begin to flower. Those persons who suffer from a severe attack of hay-fever, should begin treatment as early as February in order to be immune from hay-fever during the months of May and June. The vaccine should be used regularly at stated intervals during the flowering period and can be stopped at the end of June.

In former times only one method of fighting this sickness was known, and that was to go to an island, on the high seas, or to the mountains where the grasses begin to flower at a later period than in the plains.

Today it is considered that the sensitiveness to the pollen is a result of accidently coming in contact with a large quantity of it, causing an over sensitiveness of the affected place. It is a peculiar fact that men fall just twice as often under the ban of this sickness as women.

"I'll Say We Had a Picnic"

"TAKE it from me, Marge and I have found the life! We put the cat out, copped everything good to eat from the ice-box, and told the Harley-Davidson to take us to a picnic ground.

"I'll say we had fun! We spread the lunch under a big willow on Picnic Point—we never could have reached the place with a car—and had the best Sunday night supper I've had in weeks.

"I've been motorcyclin' on fishin' and huntin' trips, and done a lot of touring, but believe me, a picnic a la Harley-Davidson with friend wife is sure worth mentioning. If you don't believe it, just ask Marge what we're doing next Sunday afternoon."

Fishing, hunting, touring, picnicking—they're all more fun when you have a Harley-Davidson. And 50 miles for a dollar—gas, oil and tires—is real economy these days. Ask your dealer for demonstration. Or write to us for literature.

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30 x 3	$ 7.00	33 x 4	$11.75
30 x 3½	7.75	34 x 4	12.25
*32 x 3½	8.75	33 x 4½	13.25
31 x 4	9.75	34 x 4½	14.25
32 x 4	10.75	35 x 4½	15.25
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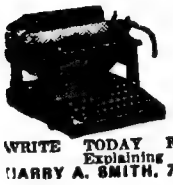

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Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

New Light Sensitive Cell

(*Continued from Page 233*)

This was prevented by the use of flashed copper ruby glass for the material of the vacuum bulb. The cells can then be exposed to much stronger radiation without harm, and it was also found that the recovery period was extremely short, which is in marked contrast to selenium. The average sensitivity of these cells is such that their dark resistance is lowered by 50 per cent in .25-foot candles, when the source is a tungsten filament. Some of the best ones, however, will lower their dark resistance by 50 per cent in .06-foot candles.

These cells have been designed so that a large per cent action is obtained between dark resistance and resistance on exposure, consequently their dark resistance is high compared to the ordinary selenium cell. The resistance in the dark of different cells may range from 5 megohms to 500 megohms. The dark resistance varies inversely with the temperature.

As a general rule, not over 50 volts should be used on these cells. On applying the potential, the resistance will be gradually lowered, but an equilibrium is soon reached. On exposure to light, the resistance is immediately lowered and upon cutting off the light, the original resistance is almost instantly reached if a very low intensity has been used. If a very sensitive galvanometer is at hand, a lower applied voltage is more satisfactory.

If these cells are to be used in connection with relay work, an audion bulb should be used because of the extreme high resistance of the thalofide cell. In such a circuit the cell is placed in the grid filament circuit with a variable potential in series, whose negative terminal (not positive) goes to the grid and positive terminal on the filament. The relay is then connected in series, including a variable potential with the positive on the plate and negative on the filament. By varying these two voltages a balance may be obtained where a very slight change of resistance of the cell in the grid filament circuit will produce a large change of current in the plate circuit which will operate the relay.

For experiments in *light telephony* the audion should again be used. In this case the cell is placed in the grid filament circuit in series with a variable potential whose positive pole goes to the grid and negative to the filament. The wireless receivers are in series with the plate and filament, including a potential with positive toward the plate and negative toward the filament.

If these cells are used to detect very small light-quantities, they should be used in series with a very delicate galvanometer and a potential of not over 50 volts. The sensitivity may also be increased greatly by *freezing* the cell and increasing the voltage to keep the dark resistance the same as at room temperature. They should not be exposed to bright lights prior to work with very low light intensity.

SIX DAYS WITHOUT OXYGEN.

A strange story comes from Cambridge, England. In order to ascertain the necessity for the human body to have oxygen apparatus when flying at great heights, a physiologist of the name of Barcroft of Kings College, Cambridge, lived for six days in a hermetically sealed glass box.

The experiment arose out of a thirty-year-old controversy as to whether it is possible to calculate the quantity of oxygen in the blood from a knowledge of the quantity of oxygen in the breath and also, as stated, to demonstrate whether it was necessary that airmen should have oxygen apparatus when flying at great heights.

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Size	Tires	Tubes	Size	Tires	Tubes
30x3	$5 50	$1 65	34x4	$9.25	$2 60
30x3½	6 50	1 80	34x4½	10.75	2 85
32x3½	7 50	2 00	35x4½	11.00	2 90
31x4	8.50	2.10	36x4½	11.50	3.00
32x4	8 75	2.45	35x5	12.25	3.20
33x4	9.00	2.50	37x5	12.75	3 35

State whether you want straight side or clincher, plain or non-skid. Send $2 deposit for each tire ordered; $1 deposit on tubes, balance C. O. D. subject to examination; 5 per cent discount if full amount is sent with order.

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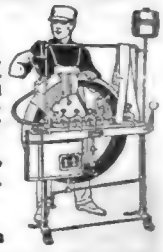

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32x4	8.25	2.40
33x4	8.50	2.50
34x4	8.75	2.60
34x4½	10.00	3.00
35x4½	11.00	3.15
36x4½	11.50	3.40
37x5	12.75	3.75

You'll reorder like thousands of others—because these guaranteed tires "make good" everywhere—everytime.

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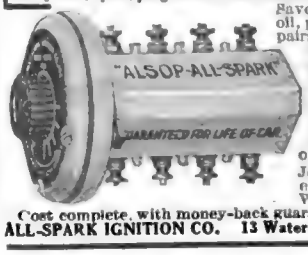

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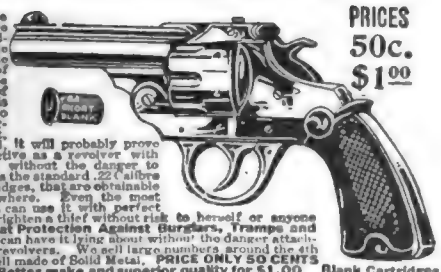

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Note Positive Safety Lock Accidental Discharge Impossible

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This Pistol may also be had in 32 Calibre, same as above, length of barrel nearly 4 inches, length over all less than 7 in. **PRICE, $20.00 postpaid. .32 Cal. Automatic Cartridges,** (by express only) **$4.50 per 100.**

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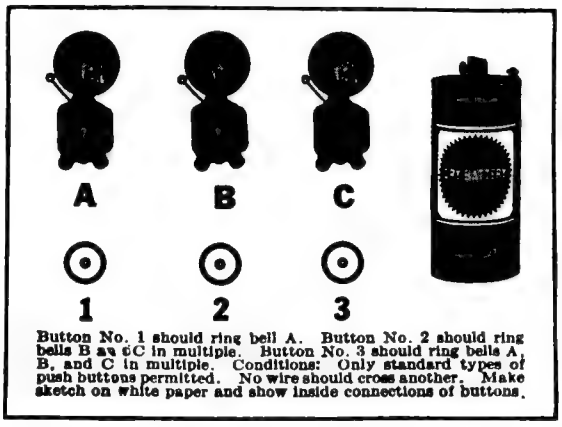

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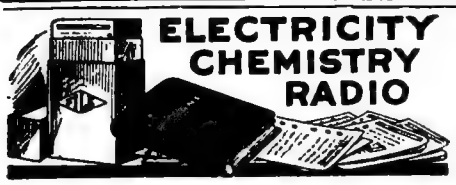

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Doctor Hackensaw's Secrets

By Clement Fezandié

(*Continued from page 228*)

"Where then does your trouble come in?"

"Well, one of the greatest troubles is that with these tremendous enlargements, any defect is correspondingly magnified. A speck of dust upon the apparatus will cloud the picture so nothing can be seen. So with an invisible flaw in the lens. With these high powers, too, the very materials that compose the glass of the lens and the celluloid of the films become so greatly magnified that their molecules blue the picture of the object I am studying—to say nothing of the grosser imperfections of the surface of the glass, and which the greatest care in the process of manufacture does not suffice to overcome. Even the chromatic distortions produced by the lenses, give trouble, tho I have partially succeeded in overcoming these."

"Then the method is a failure?"

"Not altogether. I made some valuable discoveries by the means of these instruments, but I finally reached a point where I could make no further progress. I was like a heavy automobile stuck in the mud, and my wheels turned around every time I tried to advance. And then, just as I was in the depths of despair, the idea came to me that solved all my difficulties as though by magic. Do you know what an audion is?"

"Yes, I have seen the audion bulbs used in wireless telegraphy."

"Then you will readily understand me. You see the audion has proved very useful in magnifying sounds. And a series of several audions can increase a minute sound into a very loud one that can be heard a great distance away. Now it occurred to me that as light, like sound, was nothing but a series of vibrations, the same audion that magnified sound waves could also be made to magnify the waves of light.

"This was a revelation to me. I at once set to work in this new direction, and in less than three months I had perfected an audion that would magnify a small object as well as a microscope could, and with a series of such audions I have built a super-microscope which has already revealed to me a number of nature's secrets, and which before long will reveal many others. The secret of the atom is to me a secret no longer. Nay more, I am at work now ferreting out the secret of life, and I hope soon to succeed in solving it."

"And will you allow me to look through your super-microscope?" asked Silas Rockett eagerly.

"Certainly. If you will step into my histological laboratory you can satisfy yourself of the truth of what I have been telling you."

The histological laboratory was devoted to the study of animal and vegetable tissues. On a large table in the centre of the room were a dozen large audion bulbs, so connected that a switch enabled the operator to throw one or more of them into circuit at will.

"You see," explained Doctor Hackensaw, "it is almost always necessary to explore a specimen first with a small magnifying power, in order to be able to get the best position when the high powers are to be used. I first switch on one audion, then another and another until I get just the magnification I desire."

"I see."

"Here, you perceive is the glass slide, upon which I place the specimen to be examined. This light, which can at will be made as intense or feeble as I require, is a cold light, freed from heat rays and chemical rays so as not to injure the specimen."

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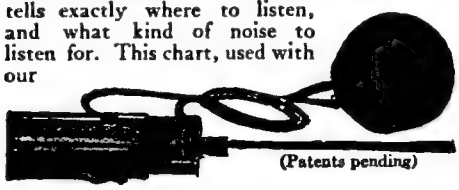

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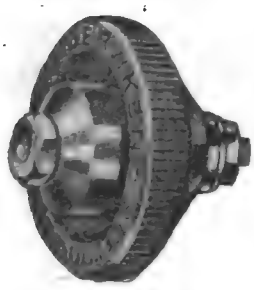

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"And what is that complicated instrument near the object glass?" asked Silas Rockett.

"That is what I call a micro-lance. You see, it would be impossible to make the delicate adjustments necessary in the specimen without some special apparatus for cutting it or moving it minute distances. This microlance is a series of levers of the finest workmanship and so arranged that a large motion of my hand moves the microscopic ends of the lever only a minute fraction of an inch. By the use of this instrument I can snip a piece from a specimen only one-millionth of an inch in diameter, with the greatest ease."

"What object will you show me, first, doctor?" asked Silas Rockett, who was becoming impatient to see some actual results.

"I think my first specimen will be a drop of rain-water," replied the doctor.

So saying he dipped a needle into a jar of water, and placed one drop of the fluid upon the object glass. Then he switched on the first audion.

"There," said he, "just seat yourself in this chair and look at this polished metal mirror on the table."

Silas Rockett fixed his gaze as directed, and was rewarded by the sight of a wriggling mass of animalcules of various shapes and sizes.

"That," said the doctor, "is practically what you would see through an ordinary microscope. Now I'll switch on the second audion," and suiting the action to the word, he moved the lever one space to the right. The drop of water was thus magnified to one hundred thousand diameters, and now the image, instead of showing a mass of wriggling animalculae, showed only one fierce-looking creature unlike anything the reporter had ever seen.

"He's a pretty monster, isn't he?" observed Doctor Hackensaw. Then he added: "One great advantage of these audions, over my first system of microscopes and photographs, is that I get a moving picture without the necessity of taking hundreds of photographs. Whenever I wish photographs, however, for careful study at leisure, I can take one or more at any magnification I wish, by switching on the proper audion and photographing the image that is reflected upon this table. There is practically no distortion and the details are clear and distinct."

"Will you switch on to the third power now please, doctor?" begged the reporter.

"Certainly," replied the doctor, and after much careful adjustment of the instrument, Silas Rockett was treated to the sight of one of the creature's hairs thru which the coursing of the blood or rather vital fluid could be plainly seen. And so it went on. The pictures were becoming more and more indistinct now, but still it was possible to form a tolerably good idea of what was thrown on the mirror. Finally Doctor Hackensaw exclaimed:

"Here is the last audion but one turned on. What can you see now?"

"I see what looks like the earth with several moons circling around it," exclaimed Silas, puzzled. "What in the world can those be?"

"Those are molecules," replied the doctor, "molecules of water. And when I turn on my last switch and get the highest power I have yet succeeded in obtaining, you will see what no man has ever seen before—you will see the atoms of hydrogen and oxygen that compose this molecule of water."

Silas Rockett gazed long and earnestly at this last image.

"It's great!" he cried. "I could look at it for hours!"

"Yes, and it would well repay your study. I am most anxious to perfect my instrument and add a few more audions so I can test the correctness of my theories regarding the atom."

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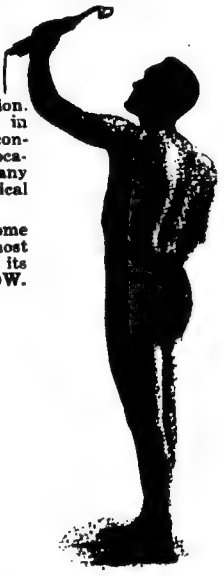

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"Are your theories different from the current ones regarding the electrons?"

"I haven't got as far as the electrons," returned the doctor. "My theory only goes as far as the atoms. My idea is—and careful study of these microscopic enlargements convince me of the truth of my views—my idea is that there is only one element, considerably lighter than hydrogen, and that all the other elements are composed of two or more atoms of this original element."

"And what is that element?"

"I don't know. I call it '*Proton*' because it is the first or original element. Every element known to man is a compound of several or many atoms of this *proton*, and the atomic weight of any of our elements shows how many atoms of *proton* it contains. Thus hydrogen whose atomic weight is low, contains very few atoms of *proton*, while radium, whose atomic weight is high, contains many atoms of *proton* crowded into each atom of radium."

"And how do you explain the *valence* of an element?"

"My theory is that each atom of *proton*, like every magnetic substance we know of, is bi-polar—that is to say, it has a positive and a negative pole. By these two poles it can hold on to any other atom of *proton* or several atoms can hold together in the same manner, the positive pole of one holding on to the negative pole of another. When the equilibrium is stable the proton atoms hold each other in a chain. Chemical change is impossible until the chain separates at some point, thus leaving a free positive and negative pole to which the atoms of *proton* in some other compound can attach themselves. If the chain breaks in only one spot, the element is univalent. If in four spots it is quad ivalent as in carbon. That, at least is my theory, and I hope to test it soon. I have even hopes of some day seeing the ultimate electrons!"

"That would be a triumph indeed! But would any practical good result from it?"

"Practical good?" exclaimed the doctor. "Why man, it would revolutionize all our industries if we thoroly understood the workings of the atoms. I am not speaking now of the subject of obtaining energy, tho that alone would be of inestimable benefit to mankind. If we understood the atoms thoroly we should at once solve a problem which has puzzled all our scientists—the problem of obtaining electricity direct fr m coal. We should do more—we should be on the road to obtaining power directly rom the atomic forces. Immense quantities of energy are stored up in the atoms and molecules, which we could unlock at pleasure, if we only had the key. Automobiles, boats, and aeroplanes would go at many times their present speed if, instead of fuel that is heavy to transport and difficult to convert into energy, we could utilize the power latent in the atoms. Why even the problem of perpetual motion might be solved."

"Perpetual motion? You surely don't mean that?"

"Indeed I do. One of our celebrated philosophers—I think it was Clerk Maxwell—put forth the *red devil* theory of perpetual motion."

"The *red devil* theory. I never heard of it!"

"Well, as you know, according to our theories the atoms in a body are in continual motion in all directions keeping up a constant bombardment. Now if we could conceive of a little red devil with a door which he could open and close at will so as to allow all the atoms traveling in one direction to pass thru, but stopping the passage of all atoms traveling in other directions, we should have a source of energy which bears no relation whatever to the force exerted by the red devil in moving his door. Hence we should have a source of perpetual energy.

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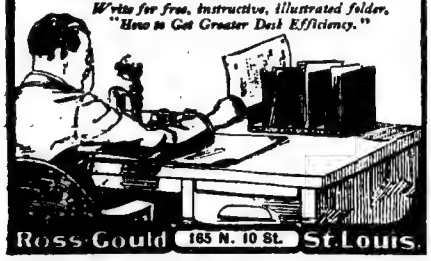

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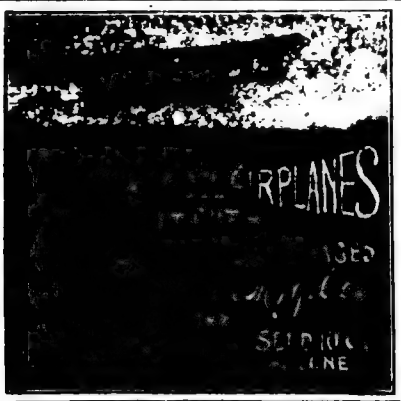

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"But, as I said before, aside from the question of energy, we should make enormous strides in every department of organic and inorganic chemistry once we had mastered the secret of the atom. All the chemicals that we manufacture now, we could make with far less expense and trouble, while thousands of new compounds would be revealed to us. Once we could see the atoms in an alloy we would understand how a small amount of tungsten so wonderfully improves the quality of steel, and we would readily discover other substances that would answer the purpose far better. The problem of a good storage-battery would also be soon solved, and we should obtain a light and powerful battery that would drive the gasoline engine off of the market.

"All diseases, properly so called, are caused by minute animal and vegetable parasites called microbes. Many of these bacteria and bacilli are known to us, but there are still a number of diseases, like cancer, for instance, whose microbes have eluded all our best microscopes. With my instrument the specific microbe that causes cancer will soon be located."

"I thought the modern theory was that cancer was not caused by a germ."

"Humph!" snorted the doctor. "That is merely because cancer is of such slow growth that it requires many years for an inoculation of the disease to take and spread. With my super-microscope the real culprit—the cancer microbe—can hide itself no longer.

"Doctor Hackensaw, will you not give me a diagram of the improved audion with which you accomplish these wonders, so I can publish it for the benefit of our readers?"

"No indeed," replied Doctor Hackensaw, shaking his head. "That is one of my secrets that I am not yet ready to give to the world. The mastery of the atom is a tremendous power, and I cannot consent to put this power into the hands of people who might make a bad use of it, until I have acquired sufficient knowledge to foil any such attempt at mischief."

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Visiting the Inside of a Watch

(*Continued from page* 213)

ears are greeted by a tremendous sound or rather a series of sounds, which can only be referred to the beating of a gigantic bass drum. A thousand other sounds issue from the giant factory, which is turning out standard time, with an accuracy of a few seconds more or less per week.

As you enter the door of the great works with your guide, the sound is almost deafening and your hat is blown off by a terrific air current resembling a whirlwind, which strikes you in the face as you step inside. You reclaim your hat and on looking upward behold a spinning fly wheel, which is oscillating at very high speed. As your gaze becomes focust on this great wheel, which carries on its perifery a number of large weights, apparently put there for the purpose of established perfect balance, you note that the wheel does not rotate continuously in one direction but seems to swing first in one direction and then in the other. Upon questioning your guide, he explains that this is known as the balance wheel, and of course your interest is aroused as to what speed this giant wheel is traveling at. The guide explains in a matter of fact way that it is oscillating at the rate of five vibrations per second, 300 vibrations per minute, or 18,000 vibrations per hour.

Exprest in feet per second we learn that the rim of the average balance wheel, in such a time-machine as this, travels at the rate of 13.75 inches per second; in one hour one of the balance weights on the perifery of this wheel, you figure mentally, will have traveled over three-fourths of a mile, or more exactly .782 mile. In one day a point on the balance wheel will have traveled 18.76 or nearly 19 miles; in one week it will have covered a distance of over 131 miles, as far as the distance from New York to Wilmington, Delaware—and in one year, a point on this remarkable wheel will have traveled a total distance of 6,831 miles.

Upon closer inspection we notice a giant steel spring, which the guide tells us is called the hairspring. It appears to be made of a very rough quality of steel and the loud buzzing noise is almost unbearable, as it contracts and expands each time the balance wheel revolves in one direction or the other. We are told that the hairspring must be made of the very finest quality of steel obtainable, and that an average size hairspring measures three one-thousandths of an inch in thickness and ten one-thousandths of an inch in width. In smaller time machines the steel hairspring may be one-half this size, or even less, in its physical dimensions.

As the great balance wheel keeps on oscillating at an astonishingly constant rate, we seem to note that it wobbles a little now and then in its bearings, and as we become interested in this phenomenon, the guide explains that this particular machine, which was built by the famous Elgin works in Illinois, has been running constantly for twenty years without having any new parts replaced, and only having been oiled at regular intervals of about once a year. The slight wobble, the guide explains, is due to the wear in the bearings and on the shaft pivots. We are told that

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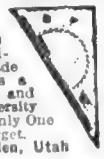

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the bearings are made of the finest jewels, such as rubies and saffires, and that the balance wheel shaft has pivots at each end, which are sometimes as small as three one-thousandths of an inch in diameter, while the jewel perforated cylinders constituting the bearings in which these pivots run, are three ten-thousandths of an inch larger in diameter than the pivot, in a new movement. In a new watch there is practically no sidewise play or wobble to even the high speed balance wheel, so accurately are the various parts made under the watchful eyes of the builders, who employ powerful magnifying glasses to examine the machine work on the various bearings and pivots, as they are being formed.

We are much impressed indeed with our visit to the time-machine works, and are convinced that we have previously had no respect at all for this wonderful piece of mechanism which mankind commonly dubs a watch.

Think for a moment of this balance wheel traveling at the rate of nearly 7,000 miles per year, and yet many of our friends and perhaps we ourselves, have never even taken the works to a watch maker to be treated to a thoro cleaning and oiling. Our brains reel when we really stop to think of how this marvelous machine with all of its complicated wheels, springs and bearings, keeps on performing its work faithfully and far more accurately than any human being could possibly do—sometimes for five and ten years without a drop of oil, except that which was placed in the bearings when the mechanism was assembled! Yes, in ten years your buzzing little balance wheel will have traveled close to 70,000 miles—a greater distance than even some of our best built modern motor cars will successfully cover before becoming ready for the scrap pile, and remember, they have simply been flooded with oil and grease from the day they left the factory. In bidding adieu to our guide and thanking him for his explanations, he tells us that every time-machine, whether large or small, should be thoroly cleaned, overhauled and oiled at least once in every twelve months.

New Magnetic Motor-less Railway

(*Continued from page* 202)

made, and the direction of motion of the car reversed. As the car moves the pole changer rotates, keeping step with the track magnets; the pole S, acted on thru the pole changer, will hold to the N pole in the track; then the N pole will attract the S. pole in the track. The commutator on the pole changer axle is rotating constantly, thereby changing the direction of the current and regulating the polarity in the car armature between the track magnets. This action continues between all the poles in the track covered by the length of the armature. The track magnets are two and a half feet from center to center and derive their necessary magnetizing current from dynamos at the power house, thru well protected wires. Every fifteen feet there is a shunt-box, which shunts the currents into the track magnets immediately under the armature of the car, as the car passes over the same space.

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Instruments that Measure the Stars

(*Continued from page 231*)

special glass, invented by the Zeiss Company to be especially transparent to the ultra-violet rays. The lens is of the doublet type, with four component lenses. The length of the telescope is 32 inches.

A prism of the same glass, and of the same size, may be placed over this objective, which then gives small spectral bands instead of the round dots of the ordinary stellar images. This instrument, altho small, is a very valuable one for various researches on the spectra of faint stars and for photographic photometry.

DETERMINING THE DISTANCE OF STARS

This machine is used for the same purpose as the instrument described, namely, for determining the distances of the stars, from photographic plates. This machine does not have the fine screw for moving the plate, but the apparatus is so arranged that the image of the star is first brought centrally under the cross-wire of the microscope, which then swings over a very accurately divided scale, thus giving the distances desired.

The fourth machine shows one of the more delicate comparators or machines, for measuring photographs taken with the 40-inch telescope, particularly for determining the distances of the stars. The plate is turned by a delicate screw, having a large graduated head. One division on the head corresponds to a motion of 1/1000 of a millimeter on the plate (equals 1/25,000 of an inch). The stars whose distances from each other are to be measured are successively brought under a fine cross-wise in the eyepiece of the microscope, through which all the observations are made. The maximum change of position of the nearest star known, as compared with faint and very distant stars around it, would be 1½ seconds of arc or, on the scale of this instrument, 0.14 millimeter or 56/10,000 of an inch. For the average star under observation, which is at least 50 times as far distant as the nearest star, this maximum displacement does not exceed 1/10,000 of an inch.

Mechanics in Animal Life

By WILLIAM BUTTERFIELD

(*Continued from page 227*)

Man is a hairy-headed individual and requires a comb to keep his hair in order; he makes one, unconsciously following a design common with another hairy creature, the spider. The surgeon has his scissors with curved ends and with notched cutting edge, so has the toucan, a bird with a large bill that it uses for cutting up both animals and vegetable food—the scissors are at the point of the bird's bill. A garden rake is a human tool, which you would hardly expect to be manufactured by Dame Nature, yet the snails have palates that are composed of gang after gang of garden rakes, that are actually used for aking up vegetable food.

But all the imitating is not carried on by man, other forms of life are similarly endowed with tools that infringe. Take the flexible webbed foot of the duck; here we have a collapsible paddle arrangement, that is not unlike the paddle scheme on the legs of the whirligig. Then the spiral breathing tubes of insects, they are not only identical with the metal spiral tubing of man's manufacture in construction, but resemble the spiral cells of plant

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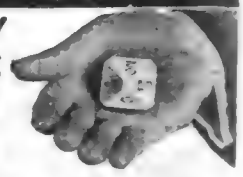

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In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

MANUFACTURING RUBBER ARTICLES

(454) F. B. Conine, Waco, Texas, asks where he can have certain sleeve protectors made out of rubber. Also where to advertise the device.

A. We would advise that you write to the various manufacturers of rubber articles and send them a copy of the patent specification asking them to give you estimates on the cost of manufacturing such a device, or better yet, have a wooden model made and then have plaster or other moulded casts forwarded to the various rubber manufacturers and obtain estimates on the price of these in large quantities.

In regard to advertising these devices we believe that the newspaper, street car and train advertising is the best medium. Magazine advertising, of course, is invaluable.

IDEA FOR DROP BOTTLE

(455) George V. Baker, Portland, Maine, enters a drop bottle and requests our advice.

A. Altho the device which you have conceived of has a few novel features to it, we do not believe that a patent will bring financial benefits, because at the present time, there are many drop bottles on the market, some of these which are used for biological purposes which are similar to yours, and which may even cause considerable trouble when securing your patent. Among these are two classes: one—where a snout is connected to the stopper; two—where the snout is directly associated with the bottle itself, as in your scheme. The only radical difference which we see in this device is the fact that a tiny hole is put in the stopper for tying the string to it.

Surely such a hole would not warrant the expenditure for a patent.

RHEOSTAT FOR ELECTRIC TOASTER.

(456) Edwin Warren, Los Angeles, Calif., desires to control the heat of an electric toaster with a rheostat and asks advice on patent for same.

A. We do not think the idea which you have evolved is very efficient; the simple reason is that it makes no difference whether a rheostat is being used or a heater is being used, the current losses are practically the same, and if the rheostat is inserted into the circuit you are losing your "juice" elsewhere than at the heater.

For this reason electric toasters are now being made with plug attachments so that a greater or a less number of wires may be placed into the circuit by simply switching over with this attachment. The rheostat involves absolute waste of power, or is proportional to I^2R, where I is current in amperes passing through rheostat and R represents its resistance in ohms, the result being expressed in watts.

AUTOMOBILE QUERIES.

(457) Wrentham Sothern, Chelsea, Mass., asks: Kindly give me advice as to the patentability and commercial value of an automobile which will have a motor in each wheel. Also a trolley feed for electrical automobiles.

A. The application of an electric motor to each wheel of an automobile is not new, and the idea is fully covered by patents. The other idea, that of charging your storage battery, is absolutely impossible for the following reasons:

It takes a number of hours running to charge a storage battery, therefore, tapping current from a trolley wire by trolley pole and wheel would be of no great value. At the same time, three hours' running surely would enable an individual to travel 50 miles, and no part of a street laid off for charging purposes would be found to be 50 miles long. Incidentally, how are you going to collect toll for the current supplied to automobilists when they may or may not have tapt as they chose? The fact that one wheel can travel faster than another will not assist in steering the automobile if the wheels are held on rigid axles, which fact is demonstrated in the case of automobiles. Due to the action of the differential, one wheel travels faster than another in rounding curves, but on other occasions one wheel may be caught on a fairly rough and the other wheel on a slippery surface—still the automobile does not turn around even though one wheel is spinning.

If, on the other hand, the wheels are not held on rigid axles but are free to move about a center you will have difficulty in synchronizing said wheels for straight traveling. We do not advise a patent.

MOTOR BEARING.

(458) Floyd Solomon, Cordela, Ga., submits a drawing of an improved cone-shaped bearing for motors. He also encloses a sketch of a lamp with two filaments, claiming that the contrivance would be economical.

A. For small motors this method of forming the bearing has been tried and you will find that same method employed in every watt hour meter.

For larger motors this bearing will answer, because of the larger friction surface.

In regard to the lamp, four years ago a New York concern manufactured a lamp regulated by a pull-chain socket, which automatically turned in a different filament, so as to dim the light or increase the light. This method is far more practical than the one in which the different filament intensities would depend upon how far the lamp has been screwed into the socket. A lamp with the ordinary base will not light up unless screwed in all the way, and, therefore, with your system you could not possibly obtain results unless all sockets were made for such device. To change the sockets would cause the owner an expense.

GUARD FOR BAND SAW.

(459) R. F. Schaber, Detroit, Mich., submits a guard for accident prevention on band saws, the guard being collapsible.

A. We believe that the device, the drawings of which you have forwarded, is a very clever arrangement, but even yet the guard is not accurately designed.

In the first place for each insertion of a different thickness of wood into the saw, the guide for raising or lowering the height of the guard must be manually operated. Perhaps rollers on both sides would dispense with this additional attention, so that the guard could be raised au-

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tomatically according to the thickness of the board.

It is necessary to guard the rollers so that the fingers cannot slip under them and move toward the saw. Many other changes will suggest themselves as you start to work upon the idea, which is clevtr enough to warrant patenting.

PRODUCTION OF SULFURIC ACID.

(460) H. Umsted, Chico, Cal., asks advice for a new method of producing sulfuric acid.

A. The production of ozone and the forming of sulfuric acid as originated seemingly by you is not new when conducted as a laboratory experiment.

Whether or not sulfuric acid can be produced at cost no greater than as now produced remains to be seen, and we therefore advise that you continue your investigation further.

For such calculation, you will have to take into consideration the amount of sulfur used, the cost of electrical current and the cost of compressing the air, etc. Each item must be figured. It may be worth your while to make these calculations. We wish you the best of success in your venture.

ROTARY GASOLINE ENGINE.

(461) August Vordermark, Indianapolis, Ind., submits a sketch of a rotary ga oline engine with the rotor set off center and four sliding gates to form compartments.

A. We fail to find anything novel or radically new in this invention, and if you will take the trouble to check up some of the patent files on rotary gasoline engines, you will find that your invention is so similar to others that you would have difficulty in even securing a patent.

In addition to this, rotary engines have not met with very great favor, in that, to our knowledge, none have been constructed which will give the same service or generate as much power as the piston type engine now employed with the exception perhaps of the Tesla engine.

With your type, there are too many moving parts constantly in motion to give the sought-for results.

MULTI-COMPARTMENT DISHES.

(462) J. Paul Van Arman, Battle Creek, Mich., says "Can I get a patent on the enclosed compartment dish? What is its financial value?"

A. There are a good many dishes divided into compartments such as you have described, and although your feature seems a little different from others now being sold, we do not believe that a patent obtained on the same would be of financial value to yourself.

Our judgment is based upon the sale of the compartment dishes now found in crockery stores.

IMPROVED CIGARETTE.

(463) Charles H. Vickery, Pittsfield, Mass., writes, "Smokers generally smoke about five-eighths of a cigarette and throw the rest away. I propose to make the end of cork and drill a hole through it."

A. Although the idea which you have suggested regarding a cigarette is rather ingenious, it is by no means clever enough to warrant a patent—at least not a profitable one.

Anyone can secure on the American market today, cigarettes which have a cardboard tip in which there is no tobacco. A very fine tissue constitutes the upper two-thirds of the cigarette, and at the oval orifice of the cigarette, a plug of cotton is inserted so as to prevent any of the ingredients of the cigarettes entering the mouth. This cotton cools the smoke considerably and also filters out some of the nicotine. The cardboard is hard enough to prevent it being comprest and the entire cigarette would be cheaper to make this way than with the end made of cork.

In view of this, we would not advise a patent on the aforementioned article.

A CONTRADICTION AND AN ANSWER.

(464) George M. Whitney, Avondale, Mo., asks a query on reversing direction of power wheel through a coiled spring drive and says, "Why does the Korting Universal inspirator put water into a boiler against the outward force of the steam-pressure?"

A. There is no way of reversing the effect from the opposite side of a coiled spring so as to obtain the effect you desire. Your query is not definite enough to give us data to work from.

Perhaps the diamond thread such as is used on the Yankee screw driver, where motion in either direction turns the shaft in one direction, or the gearing such as used in automobile transmissions, is what you desire. Of course, motion can be reversed by changing the direction of the power, and so can power be reversed without changing the direction of the motion in either of the above devices.

Your letter to this department can simply be answered as follows: The general principle is that the chamber of the inspirator is filled with steam which condenses and produces a nearly complete vacuum. Atmospheric pressure will draw the water from the tank into the chamber at such a speed that by its inertia it forces its way into the boiler against any steam pressure.

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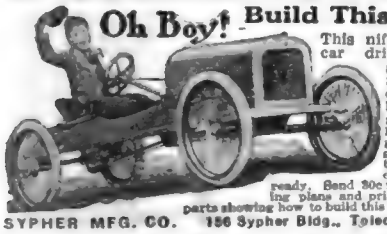

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How Electrotypes Are Made

By H. WINFIELD SECOR

(*Continued from page 216*)

trotypes are quite hard and will, therefore, stand considerably more wear than even the nickel, but the main difficulty is that they have to be kept thoroly oiled when in storage and not in use, or they will rust, thus ruining the printing face in most instances.

As shown in Fig. 3, the wax-coated metal slabs containing the grafite coated impressions are suspended in an acid bath, such as a copper sulfate solution and in a few minutes time, the electric current passing from the positive wire and thence thru the copper anode or plate, as shown in the diagram, decomposes the electrolyte and deposits a coating of metal on the grafite-coated wax impressions. In a quarter of an hour or so sufficient copper (or else nickel or iron used in the proper acid baths) is deposited, the thickness of the deposit varying from 10 to 20 thousandths of an inch, the latter value being considered a very good average for the general run of electrotypes. Where a large number of electrotypes are being made at the same time, a clever scheme is

Actual Appearance of Curved Electrotype Used in Printing Page 30 of the "May" Issue of Science and Invention

employed to keep a check on the various impression plates, so that they will not be over-deposited or *burnt*, as the electroplater would call it; a cardboard tag plainly marked with the time in hours and minutes, such as 4:30, denoting when that particular impression should be removed from the bath or plating tank, is secured on the top of the impression plate projecting above the plating tank. When it is 4:30, one of the electroplaters walks down the aisle between the plating tanks and removes all of the impressions marked with the 4:30 signs. The electro-plating energy is supplied by a low voltage, heavy amperage, direct current dynamo, the voltage varying from 4 to 6 volts usually, and the amperage ranging anywheres from 50 to several hundred amperes, depending upon the size of the plating tanks and the number of electrotypes that are to be formed at one time.

After the electrotypes have been *formed* in the plating baths they are removed and thoroly washed and by expert manipulation the copper, nickel or iron deposited impression is removed from the wax coated slab.

(*Continued on page 277*)

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How Electrotypes are Made

(*Continued from Page 275*)

We now come to stage five in the accompanying illustration, where the electrotype is to be tinned and backed up with lead, or more specifically an alloy known as *electrotype metal* which contains over 90% lead. We may digress for the moment and refer to Fig. 4, which shows a very interesting detail with regard to nickel or iron electrotypes. Here we see that the nickel (or iron) is first deposited on the grafite coated wax (or lead) impression and that later this is "backed up," or reënforced with a copper deposit. Each of these deposits are of course very thin or about the thickness of ordinary writing paper, i.e., from 10 to 20 thousandths of an inch.

FINISHING UP THE ELECTROTYPE

Referring once again to Fig. 5, we see the copper electrotype, for example, which has been removed from the wax slab on which it was electro-deposited; this is now placed printing-face down, on the bench; then it is swabbed over with a soldering flux, such as neutralized muriatic acid (acid in which pieces of zinc have been dissolved) and over this prepared thin copperplate is placed a thin layer of lead or tinfoil. The electrotype with the tinfoil over it is now placed in an iron pan about 1" deep, as shown in Fig. 6, and by means of a hand operated crane the iron pan with the electrotype lying in it, is transferred over to the tank containing molten lead or more correctly, electrotype metal. This metal is kept in a molten condition by gas burners. In a few seconds the high heat causes the tinfoil or thin sheet lead placed over the back of the electrotype, to melt and, thanks to the previous coating with the acid flux, all of the crevices in the copper sheet are thoroly tinned. The operator watches this closely and as soon as it has become well tinned, he once more brings his lifting crane into position and lifts the iron tray off of the molten lead bath and on to a steel table alongside of the furnace. He then takes a good sized ladle and starts to ladle out hot lead into the steel tray until the tray is filled with the molten metal to a depth of about 3-8 of an inch. The electrotypes, not being clean on their printing face, do not take the molten lead, with a result that when the solidified slab of the electrotype metal is lifted from the pan a few minutes later by means of heavy gloves, the electrotype is found thoroly attached to the under face of the slab of cast metal, with no lead on its face whatever. It is now ready to be machined accurately to the proper thickness and also sawed out of the large slab and made ready for mounting, either on a wooden block, on which we usually see them, or else on a solid metal block. Fig. 6 shows the electrotype resting in the tray and being heated on the molten lead bath, while Fig. 7 shows the finished slab of cast metal with the electrotype thoroly attached on its face and ready to be sawed along the dotted lines. Some very clever machines are used in the larger electrotyping plants, for sawing out the electrotypes in a perfectly square manner and also for beveling the edges, as well as routing out any unwanted metal on the face of the electrotype.

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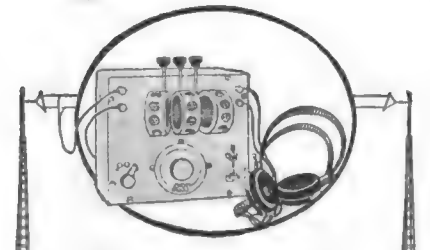

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the electrotyping plant visited in preparing this article, was the **nailing machine.** This machine spits nails and drives them thru the copper and lead electrotype and firmly into the wooden block so fast that the eye cannot follow it.

A very fine quality of wood free from knots is used of course, for mounting electrotypes on and at the present time cherry wood is used practically altogether for this work. Cherry has a fine grain and is a very homogeneous wood which will not warp with climatic changes. Previously mahogany was used for this work owing to the well-known good qualities of this wood against warping. As the diagram in Fig. 8 shows, the kiln dried cherry wood is prepared especially for electrotype mounting. It is firmly glued together to form the larger boards and the consecutive strips are reversed, as shown in the diagram, i.e., the bark side of one strip adjoins the heart side of the next strip, with the result that when climatic or other changes tend to produce warping, any two strips of wood will tend to neutralize such bending, owing to this arrangement.

How Curved Electrotypes Are Made

Those who have ever seen the large curved electrotypes corresponding to the pages of such a magazine as Science & Invention—these curved plates being required for all rotary cylinder presses—have probably often wondered how these electrotypes were made. The illustration in Fig. 9 shows the idea involved in curving these plates.

The electrotype is made in exactly the same manner as previously described and if it is to be curved the diameter or radius of the cylinder on which it is to be used must be specified by the printer. It is remarkable to note in this instance, that contrary to the usual standardization idea so much talked about in America, no two printing press builders, it seems, employ the same diameter of rolls, so that practically every order for curved electrotypes has to be made with a different pitch of diameter, depending on which printer the work is being done for. The electrotypes, backed up with lead, as previously described and which are about 1-4 inch thick in this stage, can be passed thru the rolls as shown in Fig. 9, and curved when cold. If they have laid around for two to three days or more and have become thoroly hardened and set they do not bend so perfectly and it is then the usual practise to warm them up to about 125° F. when they will curve easily. The operator first measures the diameter of the cylinder, a small length of which he has at hand as a template, and then passes the electrotype thru the rolling machine when it will take a curve approximating that which he desires, thanks to the skill and general experience of the operator in handling the electrotype and setting the machine. If necessary, he re-rolls the electrotype until it is sufficiently curved to fit on the cylinder perfectly. If you have a book or magazine page printed on a high speed cylinder press using curved electrotypes, you will probably be interested to know, or at least possibly you have also surmised that the curved plate containing the type and pictures will measure a greater length than the original layout as set up by the compositor. The stretch for 1 inch print surface on curved electrotypes is very closely .02 inch, or for a page curved electrotype 10 inches in length, the total stretch or increase of the length of the page, as it would print on the press would be 1-5 of an inch.

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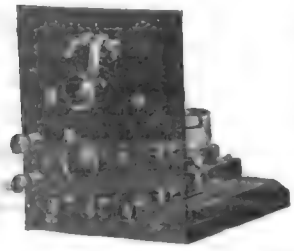

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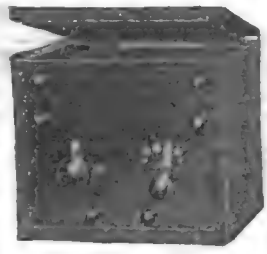

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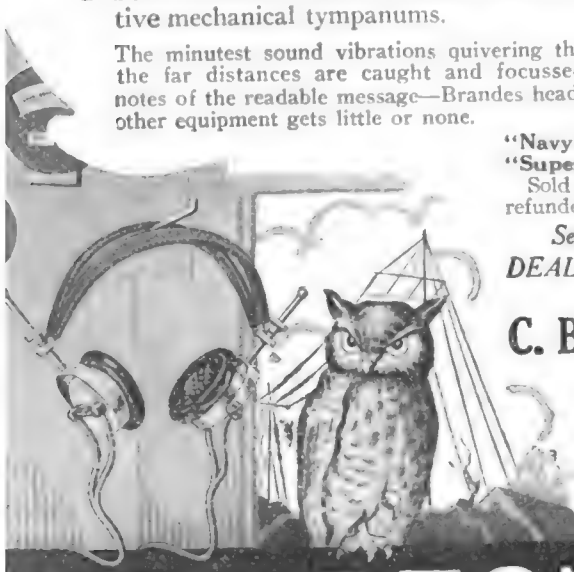

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Working Two Radio Watches at the Same Time

By ARTHUR H. LYNCH

(*Continued from page* 248)

Our government and the governments of many other nations have formulated certain regulations for radio operating, having for their basis the safety of life at sea, and future legislation and international agreement will probably take into consideration the aids to aerial as well as nautical navigation and safety which radio affords. Regardless of the part radio will eventually play in world commerce, and it is rapidly advancing its prime importance will be in connection with navigation.

Two Sets Required

Where C.W. is carried on in the merchant marine we find that most of the traffic, at least the calling, is handled on a wave of 2,400 meters rather than the customary 600 meters, used for spark work. In order to fulfill the statutes of international regulation as well as to be ready to secure as much traffic as possible, many of the commercial land stations are equipt with two complete receiving sets, one for C.W. and the other for spark. In most such shore stations, there are operators on both sets, so that there will be no loss of time in making ready to get right after the traffic from the vessels.

But on the vessels we find an entirely different situation. There are very few steamship lines which would relish having to keep two radio men on the job at the same time, which would mean additional expense. But the ships must certainly be fitted to receive on both systems within a very short time, if any material progress is to be made in ship-to-shore and ship-to-ship service. There is really no need for the dual watch, being taken care of by two men when the system here described is put into operation. There is no necessity for the ship station to communicate with more than one station at the same time, as is frequently the case at the shore stations, tho signals from spark sets, working on 600 meters, and C.W. working on 2400, should always be known to exist by the operator.

In order to accomplish this result the ship installation shown in our illustration has been arranged by the *Ship Owners' Radio Service*, on the Munson liner *"Aeolus."* Two complete receiving sets are continually kept in operation one tuned to receive spark on 600 and one arc on 2400 meters. *By connecting one receiver of the head set to the arc and the other to the spark tuner, the operator can listen in on both waves at the same time.* It should be remembered, that, while one man can do this work, it is not of the easiest nature in the world and is hardly conducive to nerve longevity. In busy sections of the globe, it is unquestionably a hard job.

Switching Arrangement

For listening-in, such an arrangement is about all that is required, but there are many circumstances in commercial operating when it is much better to receive signals from a given station with both ears. It makes for greater concentration. For instance, suppose that an operator is listening in for spark and C.W. at the same time and that he desires to copy a spark which is weak, and that there is a certain amount of static. His chances are reduced if some continuous wave station is coming in

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strongly on the other side of his head. And the static is materially increased, because his sets are tuned to two waves instead of one, with a resultant aggregate increase. Of course he can cut out the filament current or detune on the set he does not care to listen to, for the time being, and there is then a natural tendency to push the inoperative receiver off his ear. The result is that the local noises interfere with his reception. He is surely between the devil and the deep sea.

By using a head set with a separate pair of leads for each receiver and having each pair terminate in a telephone plug and connecting two jacks in parallel to each receiver, it is possible to have the signals from one set operate one receiver, while those from the other tuner operate the second receiver, or have the two receivers functioning with either tuner. In this case the receivers operate in parallel. Telephone jacks are not cheap and do not enhance the appearance of a radio station very greatly unless they are properly mounted on a panel. For this reason and in order to have the phones function in series, rather than in parallel, and to make the changeover from one method of reception to another a very simple matter the author has worked out the **switching arrangement** shown in the accompanying diagram.

A, B, C and D are the resultant terminals of the two receiving sets, that is the phones for the C.W. receiver would ordinarily be connected to A and B, while for spark they would be connected to C and D. The phones are indicated in Fig. 1 by F and F^1. Fourteen stationary, spring contacts are arranged, as shown in the diagram. They may be made of phosphor bronze and secured by two machine screws to a bakelite or other suitable support. These spring contacts are arranged in pairs as indicated by the figures and are hooked up as indicated in the diagram.

Fig. 2 represents the lay-out of a portion of the rotary element of the switch, which may be made of any solid insulating substance, upon which are fixt segments, placed as shown, which are made to pass under the spring contacts, resulting in the production of various circuits. By placing a knob on one end of the rotary element and providing it with stops, four positions may be arranged, i.e.: Off, Dual, Arc and Spark. In the drawing such a condition would follow a movement of the rotor in a direction from the reader. For the **Off** position no segments would be in contact with the spring contactors. **Dual** reception would be possible when the segments 1, 2, 6, and 7 were directly beneath the pairs of spring contactors similarly marked. Both receivers would be in series and connected for C.W. reception when the segments 1, 4 and 5 were under their respective spring contactors and likewise for spark reception, the segments 3, 4 and 7 would be the active elements in conjunction with their respective contactors.

In making a unit of this switching arrangement it is merely necessary to provide the necessary mounting and rotor element and enclose the working parts in a small case. Eight binding posts, conveniently mounted on the case would form all that was necessary in the matter of making connections between the tuners and the separately wired receivers. Four of these binding posts would be connected directly to the four left hand contactors and four to the right while the remainder of the wiring would be within the case. Alternate posts in each group would be connected to the tuner and the receiver.

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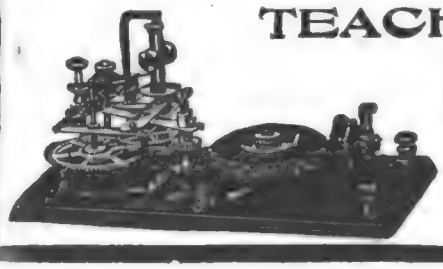

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Practical Chemical Experiments

By Prof. FLOYD L. DARROW

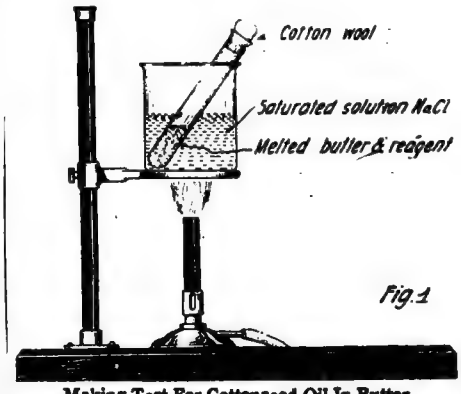
(*Continued from Page 237*)

and smoked meats. It may also be found in potted meats.

To test for nitrates prepare a solution of 1 gram of diphenylamine in 100 cc. of strong sulfuric acid. Treat a little of the meat with 2 or 3 cc. of this reagent and, if a nitrat is present, a deep blue color will instantly appear. Since the only nitrat likely to be present is that of potassium, it is hardly necessary to make the test for potassium. However a confirmatory test will do no harm.

To test for potassium extract some of the shredded meat thoroughly with water, filter the solution and concentrate it to small volume by evaporation. Dip a clean platinum wire into this solution, and holding three thicknesses of cobalt blue glass between your eyes and the Bunsen burner, place the wire in the oxidizing flame of the burner and observe the resulting color. If potassium is present a violet to lavender color will appear.

Additional Nitrat Test: Place in a test tube 2 or 3 cc. of a freshly prepared solution of ferrous sulfate. Then pour carefully down the side of the test



Making Test For Cottonseed Oil In Butter

tube an equal volume of concentrated sulfuric acid. Finally add a little of the extract obtained in the previous test. If a nitrat is present, a brown ring will appear at the juncture of the sulfuric acid and ferrous sulfate layers.

Boric Acid: To determine the presence of boric acid, frequently used as a preservative of meat, treat the meat with lime water and then burn it to an ash in a porcelain crucible placed over a Bunsen burner. Slightly acidify the ash with hydrochloric acid and soak a piece of turmeric paper in the solution. When dried this paper will be colored rose-red if boric acid is present. If the paper is moistened with ammonia, it turns to an olive color.

Sulfurous Acid: Sulfurous acid is one of the most common meat preservatives. Place some of the finely divided meat on a paper saturated with starch and potassium iodate solution and moistened with a 1:8 solution of sulfuric acid. If sulfurous acid is present a deep blue color at once forms. The sulfurous acid reduces the iodate liberating iodine and this with the paper gives a blue color.

Another method, and one that may be employed with other foods than meat, consists in placing about 25 grams of the finely divided meat or other foodstuff in a 200cc. Erlenmeyer flask. Add

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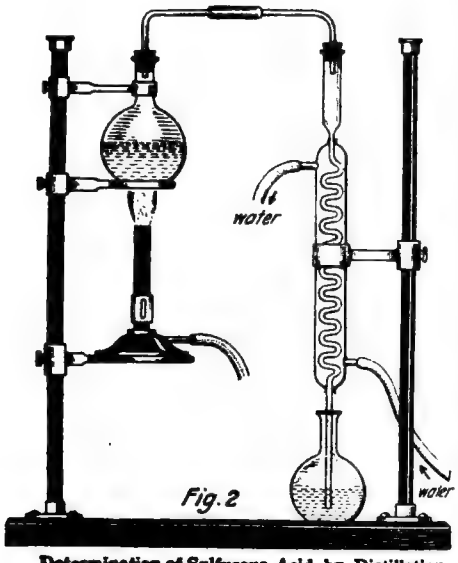
enough water to form a thin paste and a few grams of pure zinc. Then pour into the flask about 15 cc. of chemically pure hydrochloric acid and cover the mouth of the flask with a filter paper moistened with lead nitrate solution. Upon heating gently the filter paper will become blackened if sulfurous acid or its salts are present.

Distillation Method of Leach: Arrange apparatus as shown in the accompanying photograph and Figure 2. Introduce into the flask about 150 grams of the meat that has been first reduced to a paste and acidify it with 5 cc. of a 20 per cent solution of phosforic acid. Having arranged the apparatus so that the outlet of the condenser will dip beneath the surface of water about 20 cc. contained in a small flask, distil the mixture. After about 25 cc. have been distilled off, add to the distillate about 10 cc. of bromine water and boil for 2 minutes. (The bromine water may be obtained by shaking a few drops of bromine with a test tube of water for a few moments.) Immediately after the boiling action with bromine water add a little barium chlorid solution. A white precipitate indicates sulfurous acid.

This test may also be used with other food-stuffs than meat.



Determination of Sulfurous Acid by Distillation Method

Salicylic Acid: This substance is a very familiar preservative of foods and beverages. To determine its presence in meat slightly acidify some of the lean meat with a strong solution of glacial phosforic acid and extract by shaking with ether. Evaporate the extract to dryness and test the residue with a drop of ferric chlorid solution. A deep violet coloration shows the presence of salicylic acid. As ether is exceedingly inflammable, the extract should be evaporated over a water bath using a low flame.

Benzoic Acid: Everyone is familiar with the statement, "Not over one-tenth of one per cent of benzoate of soda" so frequently seen on ketchup bottles. This is a salt of benzoic acid and much used as a preservative.

To determine the presence of this substance prepare a sample of the meat by heating 50 grams of it in 50 cc. of water. Then add 10 cc. of a strong solution of glacial phosforic acid and filter the mixture thru a cotton bag. (Glacial phosforic acid is a transparent solid, frequently called metaphosforic acid and easily soluble in water.) Exactly neu-

(*Continued on page* 285)

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185 Illustrations

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This list is only a partial one. You must positively see this wonderful book to appreciate it.

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And Oh yes! Before we forget it. If you are in need of the following, remember **"Rasco has it."** These are only a few things contained in this catalog: Lugs, Nuts, Dials, Knobs, Washers, Crystals, Litz Wire, Selenium, Cord Tips, Cap Nuts, Tin Foils, Name Plates, Spring Posts, Switch Parts, Metal Ribbon, Carbon Balls, Binding Posts, Switch Points, Switch Levers, Carbon Grains, Metal Pointers, Contact Points, Low Melting Metal, Carbon Diaphragms, Screws, Copper Strip, "Spaghetti," Name Plates, Sliders, Mica, Switches, Resistance Wire, Variocoupler Rotors, Test Clips, Condenser Plates, Condensers, Antenna Connectors, Threaded Brass Rod, Ground Clamps, Etc., Etc.

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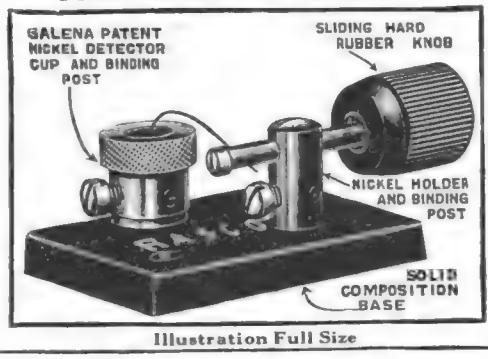
GALENA PATENT NICKEL DETECTOR CUP AND BINDING POST
SLIDING HARD RUBBER KNOB
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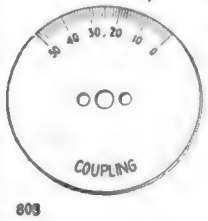

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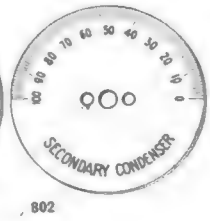

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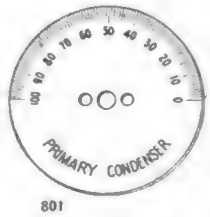

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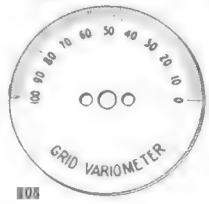

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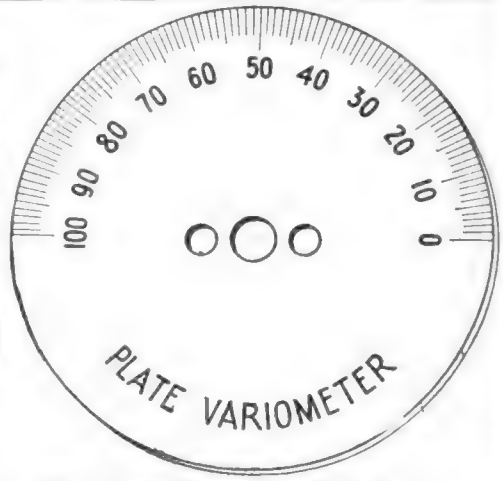

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Practical Chemical Experiments

(*Continued from Page 283*)

tralize the extract with sodium hydroxid and evaporate the solution nearly to dryness. Moisten the residue with 3 cc. of concentrated sulfuric acid and heat until white fumes appear. At this point add a half dozen crystals of potassium nitrat and continue the heating until a nearly colorless solution results. After cooling add ammonia in excess, i.e., until the acid has been neutralized and the solution is alkaline. Then place in a test tube and very carefully add one or two drops of a solution of ammonium sulfid, obtained by passing hydrogen sulfid gas into ammonia for some time. If the surface of the liquid at the juncture of the two layers immediately becomes red, benzoic acid is undoubtedly present.

Starch: Cracker and bread crumbs are frequently added to sausage, deviled meat, etc. Since these substances all contain starch their presence may be best detected by making the starch test. Boil some of the sample in water, filter and when cool add a drop or two of a solution of iodine. If starch is present the usual blue color will appear.

Diseased Meat: Prepare a mixture of concentrated hydrochloric acid, 3 cc. of alcohol and 1 cc. of ether. Hold the sample of meat over this mixture and if white fumes of ammonium chloride appear there will be ground for strong suspicions of diseased condition.

BAKING POWDERS

Baking powders consist of a mixture of sodium bicarbonate and some acid substance such as cream of tartar, calcium acid phosphate, or alum. Sometimes free tartaric acid is used as the acid ingredient. Other substances, as sulfates, gypsum, ammonium salts, and earthy material are sometimes present.

Tartaric Acid: This is the most healthful acid ingredient that a baking powder can contain and it may be present either in the free state or combined as potassium acid tartrate, known as cream of tartar.

Very often starch is present in baking powder and if so its presence must first be determined by boiling a little of the sample with water, diluting, and making the usual test with tincture of iodine, obtaining the deep blue color.

If starch is absent the following test may be made for tartaric acid whether free or combined: Mix a little of the powder with some dry resorcin, add a few drops of sulfuric acid and heat gently. If tartrates are present a rose-red color forms which disappears upon diluting with water.

When starch is present, shake about 5 grams of the powder with 250 cc. of cold water and let the insoluble matter settle. Filter and evaporate the filtrate to dryness. Then add to the residue a few drops of a one per cent solution of resorcin, followed by 3 cc. of concentrated sulfuric acid and gentle heating. As before a rose-red color will appear if tartaric acid is present.

Phosfates: Shake a little of the baking powder with cold water and filter if necessary. Add a few drops of this solution to a solution of ammonium molybdate in nitric acid. If phosfates are present a lemon-yellow color will appear.

Sulfates: Boil a small portion of the sample with hydrochloric acid for a few moments and then add a little of a solu-

(*Continued on page 289*)

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32x3½	8.50	2.40	34x4	12.00	2.90	33x4½	14.50	3.25
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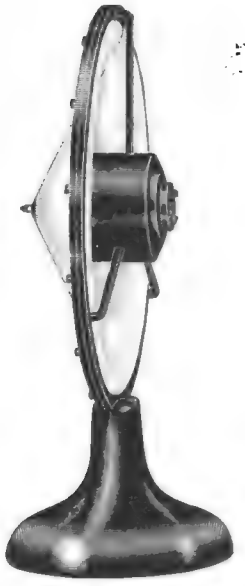

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Electric Power from a Spigot

(*Continued from Page 239*)

accompanying diagrams will undoubtedly prove of interest. Fig. 1 shows a complete wiring diagram or circuit for the direct current charging dynamo, automatic charging cut-out or circuit-breaker, fused switches as well as storage battery and lamps. This outfit, if employed in connection with a small D. C. dynamo or else a telephone magneto fitted with a commutator and brushes, developing 8 to 10 volts and 8 to 9 amperes or requiring about 1-5 HP to run at full capacity, will successfully charge a 6 volt, 60 ampere-hour lead-plate storage battery. This three cell battery, the standard discharge time for which is eight hours, will take care of 6 to 7, 6 watt or 6 C. P. tungsten lamps for eight to nine hours. The dynamo, to run continuously, will have to charge the 6 volt, 60 A. H. battery at about a 7 1-2 ampere rate for eight hours, to give it a full charge. It would have to charge the battery much longer, of course, if the dynamo operated only at intervals, as when water happened to be drawn from the spigot. If the dynamo could be operated sufficiently steadily to charge two 6 volt, 60 A. H. storage batteries, these when fully charged would take care of 12 to 14 6 watt lamps for eight to nine hours; or if the battery should be left connected to the dynamo, thru the automatic cut-out of course, while the lights were being operated, then the lamp load would be shared between the dynamo and the battery.

A few words about the charging dynamo and the installation of the batteries. The dynamo must always develop a voltage of about 10 per cent higher than the counter E. M. F. from the battery at any moment, in order to force electric energy into it, or otherwise the battery will discharge back thru the dynamo (providing no automatic cut-out were used).

Most people are not interested in 6 watt, 6 C. P. tungsten lamps, but use at least a 40 watt tungsten lamp, giving approximately 40 C. P. For the benefit of the average householder who is interested in this idea of providing electric lights from the spigot, data is given below on a more pretentious outfit operating at 36 volts. This potential is commonly used in connection with isolated farm lighting plants today, and standard lamps and other apparatus is available for this potential. It will be seen after looking over these paragraphs that it will take a pretty husky turbine and a considerable amount of water pressure (the small water turbines require at least 60 pounds pressure to show anything like efficient results, and they really need 80 to 100 pounds pressure to do good work) and for driving a 40 volt D. C. generator capable of delivering 12 1-2 amperes or about 500 watts for charging a 36 volt, 100 ampere-hour storage battery, will require about 3-4 H. P., at least, at the turbine shaft. This calculation is based on the fact that the battery is recharged at the usual rate, requiring eight hours, that the potential increases from 36 to 40 volts, as the battery counter E. M. F. increases, all this with an average charging current of 12 1-2 amperes. Of course, if the lights were not used very often each day, it would be possible to keep a small charge trickling into the

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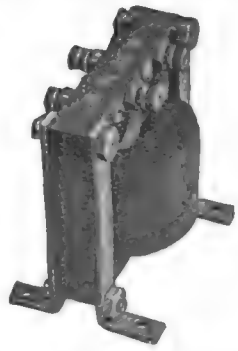

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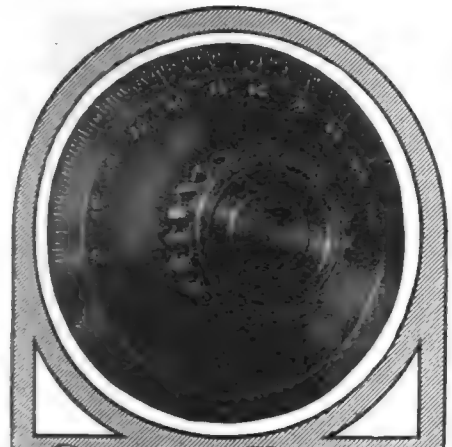

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battery every now and then, by means of a lower wattage dynamo wound to give 36 to 40 volts, but only a fraction of the current in amperes stated above, or say 2 to 3 amperes.

For those interested, a diagram is given at Fig. 2, showing how an automatic charging cut-out is constructed, and at Fig. 3 a special wiring diagram is presented which was designed to permit charging three 12 volt 100 A. H. storage batteries on parallel from a 16 volt dynamo and then by simply throwing over the switch would enable the batteries to discharge in series, so as to provide 36 volts, average potential. This figures out, as will be seen all the way thru, at about 2 volts per cell mean potential, but the rate varies during discharge, being about 2.2 volts at the start and dropping to about 1.8 volts at the end of the discharge. If the three 12 volt 100 A. H. storage batteries were fully charged, they would be capable of lighting 10 40 watt, 40 C. P. 36 volt tungsten lamps at one time, for a period of about eight hours. This has been figured out for the standard or best rate for lead storage batteries, which is taken as eight hours.

The special series-parallel charge and discharge switch shown at Fig. 3 can be constructed from three double-pole double-throw switches mounted together and with the handles of the three switches firmly joined by a single bar, provided with a single handle if desired. The switch can then be thrown as one switch.

The positive pole of the dynamo must always come to the positive pole of the storage battery and this must be watched very carefully. Regarding the automatic cut-out or circuit breaker, this can be purchased from small electric lighting plant supply houses or manufacturers or else can be built by the experimenter himself. The action of this is as follows: For 10 or 15 volt potentials the shunt or high resistance, fine wire coil may have a value of 100 ohms or more; for small charging systems, such as 75 watt outfits, such a charging relay can be built from a discarded bell or buzzer, rewinding it to suit. The series coil on the cut-out is wound with No. 12 insulated magnet wire for 10 to 15 ampere currents, while the fine wire coil can be wound with about No. 28 insulated magnet wire. Now when the dynamo speeds up sufficiently to produce a higher voltage than that given by the battery, the pull on the armature of the cut-out is varied, until it will just close, in this case opening the shunt coil circuit. With the charging voltage right, i. e., higher than that of the battery, the armature when it closes, makes contact with the series coil terminal and the charging current from the dynamo passes thru the armature and into the battery, as becomes perfectly clear from Fig. 1.

If at any moment the charging dynamo should drop in speed and consequently in voltage, the counter E. M. F. produces a reverse current from the battery, passing thru the series coil now holding the relay armature down, creating a reverse magnetic polarity in the iron core, which will cause the armature to be released. This does two things, it puts the circuit breaker in condition to close the circuit again, as soon as the voltage and speed of the charging dynamo have accelerated to the proper value, and most important of all, it has prevented the storage battery from discharging back thru the dynamo, which will be liable to demagnetize or burn it out, besides running down the storage battery and possibly sulfating and buckling it.

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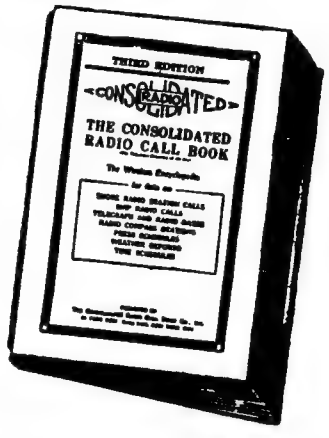

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Practical Chemical Experiments

(*Continued from Page 285*)

tion of barium chloride. If sulfates are present a white precipitate will appear.

Calcium: If either gypsum or calcium acid phosfate are present this element will be found. To half a test tube of the filtered solution add a few drops of a solution of ammonium oxalate. If a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid, appears, calcium is present.

Alum: Heat about 2 grams of the baking powder in a crucible until an ash has been formed. Extract this ash with boiling water and filter. Add to the filtrate ammonium chloride solution until a distinct odor of ammonia is perceptible. If alum is present a white flocculent precipitate will result.

Ammonium Compounds: To some of the cold water extract of the powder add a solution of sodium hydroxide and boil. If ammonium compounds are present this fact will be shown by holding red litmus paper in the escaping steam and noting the blue color.

Earthy Materials: If upon treating the powder with warm potassium hydroxide solution, a residue is obtained, the presence of earthy materials is indicated.

VINEGAR

Natural vinegars are obtained by the fermentation of cider or wine and contain about 4 or 5 per cent of acetic acid together with some malic acid. There may also be present artificial coloring matter and free mineral acids.

Free Mineral Acids: Place some of the vinegar in a crucible and heat it over the Bunsen flame until an ash is formed. Dissolve this ash in a little water and test the solution with litmus paper. The ash of pure cider always shows an alkaline reaction, i.e., it turns red litmus blue. If the ash should show a neutral reaction there would be a very positive indication of a free mineral acid.

Sulfuric Acid: If sulfuric acid is present a charred mass will be left upon evaporation over a water bath.

A confirmatory test consists in evaporating 100 cc. of the vinegar to one-tenth its volume and after cooling add 50 cc. of alcohol. Filter and test the filtrate with barium chloride solution. If a white precipitate appears free sulfuric acid is present.

Hydrochloric Acid: With a distilling flask and a condenser, similar to that used in the test for sulfurous acid, distil off one-half of a definite quantity of the vinegar under examination. To the distillate add a few drops of silver nitrate solution. A white precipitate shows the presence of hydrochloric acid.

Spices: To show the presence of spices neutralize a sample of the vinegar with sodium carbonate and taste the product.

Wine Vinegar: Wine vinegar will always contain tartar. Evaporate some of the vinegar to dryness and treat the residue with alcohol. If tartar is present there will be a granular residue of undissolved matter. If you wish to prove that this is tartar, pour off the alcohol, dissolve the residue in a little hot water, cool, and rub the inside of the beaker with a glass rod. If tartar is present crystals of acid potassium tartrate will form where the rod touches the sides of the beaker. If a little alcohol is added to the solution the test will be obtained more easily.

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Here are just a few items to show you how wireless is sweeping over the world like wildfire. And even now Wireless has only taken a few short steps compared to the amazing expansion that is now on the way. Surely this World-Sweep of Wireless holds a real message for those who want to cash in big on a fascinating, uncrowded field filled with amazing opportunities.

A $20,000,000 American corporation has been formed to establish wireless stations in every part of the globe.

The U. S. Merchant Marine operates over 30,000 vessels. Wireless is now a necessity on ships.

The Chicago Tribune now receives foreign news by wireless. Other papers are calling upon Wireless too.

Huge wireless stations are springing up all over the world. Saint Assise, France; Bordeaux, Ville Juif, and Lyons, France; Peking, China; Geneva, Switzerland; Shanghai, China; Fiji Islands; Warsaw, Poland—and these are but a few.

Many railroads are calling upon wireless to dispatch trains and carry on communication. The Lackawanna, The Louisville & Nashville, The Canadian-Pacific, The Nashville, Chattanooga & St. Louis, are some of them.—New York, Cleveland, Chicago and Detroit are connected by an inter-city wireless service.

Criminals are being intercepted by wireless through the Police Department of New York, Dallas, Chicago, and other cities.

Brokers, Bankers, Merchants, Manufacturers and other business concerns are calling upon wireless. John Wanamaker, Goodyear Rubber Co., Standard Oil Co., New York Stock Exchange, are only a few.

Farmers are getting Market and Weather reports daily by wireless in all sections of the country.

New wireless stations are springing up in every part of America. Belfast, Maine; Cape May, N. J.; East Pittsburgh, Pa.; San Francisco, Cal.; Helena, Montana; Seattle, Washington; Mobile, Alabama—these are but a few.

The Aerial Mail Service of the Post Office Department already has 12 radio stations in operation.

The Japanese are constructing a powerful station in the Orient.

A big new wireless service is being established between England and France.

The Federal Telegraph Co. is establishing a complete chain of stations on the Pacific Coast.

Messages are sent from the Philippine Islands to Washington (10,000 miles) in 3 minutes.

Daily wireless service between the United States and Japan is in full operation.—St. Johns, New Foundland, is operating a large service.

Danzig, in Europe, is carrying on large wireless operations.

Three tremendous stations are operating on Long Island at Easthampton, Port Jefferson, and East Moriches.

South America is planning to establish a chain of stations at Rio de Janeiro, Asuncion, Buenos Aires and Montevideo.

One single American concern offers wireless communication between the United States and France, England, Germany, Norway, Denmark, Sweden, Finland, Poland, Honolulu and Japan.

And these are only a few of the examples showing how Wireless expansion is spreading over the whole earth. It brings you amazing opportunities—and you can now easily grasp them.

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You yourself have probably read and heard about the enormous world-wide strides Wireless has made in a few short years. But do you know that now YOU can easily share the amazing opportunities that have opened up? Do you know that through a wonderful new invention YOU can now quickly and easily learn Wireless **at home in your spare time? A fascinating big-pay field that you can put your heart into is eagerly calling for you. And now—no matter whether you** know a thing about Wireless or about Electricity at the present time—you can speedily step into the wonderful future Wireless offers you!

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From the land, too, comes the call of the new forces that have formed to make Wireless the greatest means of communication in existence. Just a few of the items showing this amazing sweep of expansion are shown here.

AMATEURS

Have you ever realized that Wireless offers you a splendid field, filled with good opportunities and interesting work? And that the present—attractive as it is—is only a little indication of the wonderful future that Wireless offers you! Learn at home in spare time all about Wireless. Build up your present knowledge and be ready to share this opportunity-filled future. Cash in on the world's expansion. Let us tell you how!

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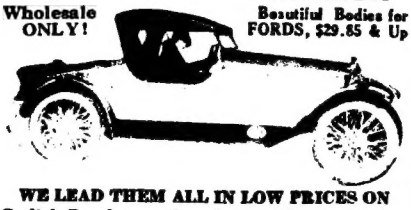

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How to Build a Violin

By HARRY L. GRAY

(*Continued from page* 240)

working on. It is then bedded in this with the flat side up, and the piece will be held without danger of splitting.

The piece is then worked out roughly with the gouge; care should be taken not to take out too much before you commence to use the calipers. The piece must then be carefully worked, using calipers and working down to the required thickness, see Fig. 10. The thickest part is one-eighth inch, and the thinnest part one-sixteenth of an inch. Care should be taken to make the thickness exactly as called for. About three-eighth inch margin should be left flat all around, and more, at each end where it is glued to the blocks. It is not necessary to sandpaper the inside as much as the outside. The holes known as the "F" holes should now be cut in the top and it is finished.

When we have the top and back finished, we will start on the sides. It will be necessary to make a form as shown in Fig. 2A. As it is not likely that the dimensions here given will conform to the pattern you have used for the top and back, it will be necessary to build your form in accordance with the pattern you have used. The form should be one-eighth inch smaller all around than the top, then the notches are cut. The notch on the large end should be 2½ inches and on the opposite end 2 inches wide.

The form can be of any available wood, but should be made in two layers with the grains running in opposite directions. It should be 1¼ inch thick. A row of five-eighths or one-half inch holes are bored all around. The exact position of the holes is immaterial, as they are only used in clamping. The form is then sandpapered smooth and given a coat of paraffin wax. This will prevent the sides sticking to the form.

Blocks are now fitted in the notches as in Fig. 2B. The blocks are made from soft pine, or the same material as the top. These should be carefully cut to the required shape. They should be just tight enough so they can be easily slipt out when the sides are finished.

The blocks in, we are ready to bend the sides: The sides should be a trifle more than 1¼ inches wide, and about one-sixteenth of an inch thick. Six strips are used, the joints being on the blocks to which they are glued.

To bend, immerse the strips in water, then take a small piece of hollow metal tube or pipe about one inch in diameter, and arrange a small alcohol lamp underneath to keep it hot. Have a strip of lead about one-sixteenth inch thick and a little larger than the pieces to be bent. Bend the piece and the lead together, slowly. It may be necessary to wet and bend several times before the right curve is obtained.

The two short pieces are to be bent first. These two pieces are then glued in place on the form, and the ends left projecting, see Fig. 2B. After the glue has set the ends are trimmed ready for the joint. Do not try to glue on any of the others till these two are set.

The clamps used are the ordinary iron quilt frame clamps. About 18 are needed.

Then bend the two pieces for the small end next. As the top joint comes where the neck will be fitted, it is not necessary to make a tight joint here. The ends need not be closer than one-half inch of each other.

The two strips for the lower part must be matched to a perfect joint exactly in the center of the block. After the last pieces glued have set at least 12 hours, remove the clamps.

Scrape off all surplus glue, trim up the corners. Take a sandpaper block and sand-

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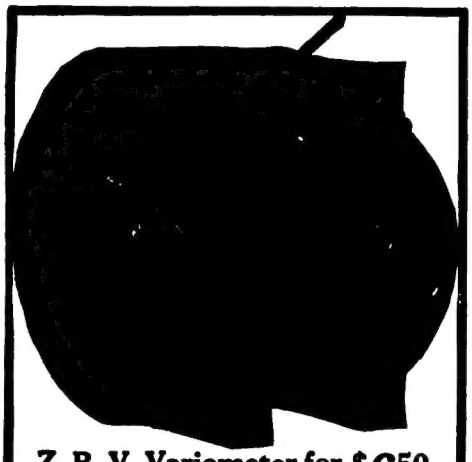

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paper the edges down flush with the form. Then sandpaper the whole as it will be easier now than later. The sides are now ready to be removed from the form.

Slip the blocks out a little at a time till all are out. After being removed, trim blocks as in Fig. 4.

The next step is the linings: These are of pine, about one-eighth inch wide. Similar to a little molding. These are glued to the edges to strengthen the sides and afford more surface for gluing the top and back too, see Figs. 4 and 5. These are only put on one side at present, the ends should just come to the blocks.

The frame-work is now put back on the form, of course it will not go down as far as before on account of the linings in place, but this does not matter. The edge is now gone over with the sandpaper block till the linings are flush with the balance, and we are ready to glue on the top. Put on a clamp or two, to hold the sides to the form as they will fit very loose now since the blocks are trimmed off.

Get your glue ready. I might here mention that the glue should never be allowed to boil as this spoils it. Have it as hot as possible *without boiling*. Always put glue on both the parts to be joined.

Put on your glue and lay on the top with the joint exactly matching the joint on the lower block. See that the edge projects the same amount all around and clamp down. Use plenty of clamps and put pieces of cloth under each one to avoid marring the wood. Leave set for 24 hours then remove clamps and we are thru with the form.

Now the bass bar should be put in. See Fig. 7 for dimensions and shape. Glue in position as shown in Fig. 1C. The bass bar should come directly under the "G" string.

Next comes the neck. Necks can be purchased from most any music house, with the scroll already carved, but the balance of it in the rough. Work down to the shape and dimensions given in Fig. 7. Cut the notch in the top block. Make the slant of the neck so that the large end of the fingerboard will be three-fourths inch high from the violin top, then glue in place.

We are now ready to glue on the back. Put the linings in place on the back side. Trim down the neck flush with the block where it is set in. Smooth off the linings, and put the back in place with the center joint exactly matching the other joint on the lower end. Also see that the joint comes exactly in the center of the neck at the upper end. If the part of the back that is glued to the neck is a little large, it should be trimmed down to the same size as the neck after the glue has set.

Bore a hole for the end pin exactly in the center of the joint on the lower block. This should be a taper hole.

Fit in the saddle. This is of ebony. The top is notched out till it sets directly on the block. See Fig. 8.

The violin is now ready to be sandpapered. Scrape off all surplus glue. Start with No. 0 sandpaper and finish with No. 00 then put on a coat of sizing.

The fingerboard, pegs, tailpiece, etc., can all be purchased ready for use. The sound post is made of pine about one-quarter inch in diameter; it is placed one-eighth inch back of the right foot of the bridge. It is not glued in. The right length must be found by experiment and it can be pulled in place with a string or a regular soundpost setter be used. The bridge is to be placed opposite the notches in the "F" holes.

The instrument is now ready to be played. It is best not to varnish for a while. When ready to do so, only regular violin varnish must be used. This will cost about $3.00.

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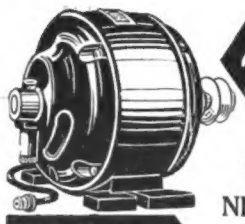

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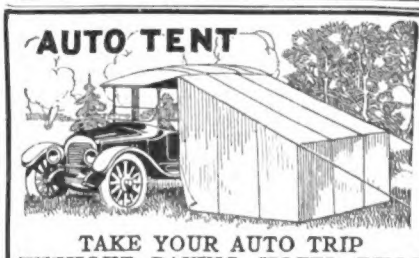

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